Library AUG 1 2 1932

JOURNAL OF MAMMALOGY

Vol. 13 AUGUST, 1932 No. 3

AMERICAN SOCIETY OF MAMMALOGISTS

ALLEN MEMORIAL NUMBER

The American Society of Mammalogists

Founded April 3, 1919
Incorporated April 29, 1920

MARCUS W. LYON, JR., *President*
H. E. ANTHONY, T. S. PALMER, *Vice-Presidents*
H. H. LANE, *Recording Secretary*
ROBERT T. HATT, *Corresponding Secretary*
MRS. VIOLA S. SNYDER, *Treasurer*
EDWARD A. PREBLE, *Chairman, Editorial Board*

Additional Directors

1931–1933	1932–1934
JOSEPH GRINNELL	W. K. GREGORY
REMINGTON KELLOGG	RUDOLPH M. ANDERSON
A. BRAZIER HOWELL	CHAS. C. ADAMS
W. E. SAUNDERS	H. H. T. JACKSON
WHARTON HUBER	LEE R. DICE

C. HART MERRIAM
E. W. NELSON
WILFRED H. OSGOOD } Past-Presidents
GLOVER M. ALLEN
WITMER STONE

Trustees

F. C. WALCOTT (1930) H. E. ANTHONY (1931) W. K. GREGORY (1932)

Standing Committees

Editorial: Edward A. Preble, *Chairman.* Glover M. Allen, Arthur H. Howell, Remington Kellogg, Gerrit S. Miller, Jr., George B. Wislocki.

Life Histories and Ecology: O. J. Murie, *Chairman.* R. K. Enders, C. E. Johnson, E. Raymond Hall, Robert T. Hatt.

Anatomy and Phylogeny: A. Brazier Howell, *Chairman.* W. K. Gregory, Carl Hartman, Adolph H. Schultz, George B. Wislocki.

Bibliography: Gerrit S. Miller, Jr., *Chairman.* Lee R. Dice, Paul Moody, Arthur J. Poole, William L. Straus, Jr., Horace Elmer Wood, II.

Marine Mammals: T. S. Palmer, *Chairman.* Glover M. Allen, Barton W. Evermann, Remington Kellogg, Gerrit S. Miller, Jr.

Economic Mammalogy: Charles E. Johnson, *Chairman.* S. G. Jewett, Adolph Murie, M. P. Skinner, G. M. Wright.

Conservation of Land Mammals: H. E. Anthony, *Chairman.* Lee R. Dice, Madison Grant, Joseph Grinnell, T. S. Palmer.

Nomenclature: Wilfred H. Osgood, *Chairman.* Glover M. Allen, Arthur H. Howell, Gerrit S. Miller, Jr., T. S. Palmer.

Membership: W. P. Harris, Jr., *Chairman.* R. M. Anderson, Vernon Bailey, Joseph Dixon, Tappan Gregory, W. P. Taylor, M. R. Thorpe.

The Journal of Mammalogy

Subscription rates, $4.00 per year; single numbers $1.00 each. Sent free to all members of the American Society of Mammalogists not in arrears for dues.

Subscriptions, changes of addresses, requests for missing numbers, applications for advertising rates, etc., should be sent to the corresponding secretary, Robert T. Hatt, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y.

Manuscripts for publication, books and papers for notice and reviews, etc., should be sent to Edward A. Preble, U. S. Biological Survey, Washington, D. C.

Entered as second-class matter, November 22, 1919, at the Postoffice, Baltimore, Md., under the Act of March 3, 1879.

Made in United States of America

JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

VOL. 13 AUGUST, 1932 No. 3

THE SONGS OF MICE

BY LEE R. DICE

Singing house mice (*Mus musculus* or related species) have been reported from numerous localities in the United States, and there are records for Europe, China, Tunis, and Yucatan. It therefore appears that singing is a habit of house mice everywhere. The bibliography given at the end of this paper indicates the widespread occurrence of the singing habit in these animals.

In a house in Detroit, Michigan, a few years ago, a singing mouse was captured by Mr. J. L. Clark. Several months later, in March, 1926, Mr. Clark gave this musical mouse to the University of Michigan for study. It was a typical *Mus musculus*. Attention was called to the mouse by his habit of song, and he was said by Mr. Clark to sing particularly loudly when being pursued, and his location was thereby at all times evident, facilitating his capture. Such a habit would evidently be a disadvantage to an animal pursued by a predator able to hear the song, and natural selection would probably tend to eliminate individual mice with the singing habit.

This animal had been kept for a time in a cage by Mr. Clark for the pleasure of his song and to entertain his friends. Perhaps some similar occurrence gave rise to the report by Hugo (1877, p. 87) that the Chinese keep singing mice in cages, but there is no evidence that the singing habit is more common in Chinese mice than in those of other countries.

The song given by this mouse was very bird-like in quality, but weak in volume, characteristics which have been noted by many observers of the habit. On some occasions the song could be clearly heard at a distance of 25 feet or even more, but more commonly it did not carry distinctly more than about ten feet. Generally the song consisted of a

series of pleasing musical chirps and twitters, but there was considerable variation in the notes and tones produced as well as in the volume. A trained musician, Mrs. Martha Grim, found the tones not pure, but much mixed with overtones, so that the determination of the precise pitch of any note was not usually possible. However, the notes could easily be heard by the human ear, and the range was at least two octaves. The number of notes per second varied between two and six or more. No particular theme could be recognized; consequently the song was somewhat monotonous.

The production of song by this mouse, which was an adult male, was erratic and sometimes days would elapse without any manifestation of his ability, but usually there was some sort of a song almost every evening, and occasionally at other times of the day. He sang best when he was excited but not greatly frightened. His best exhibition was given when he was returned to the mouse room after an absence of a week or more—perhaps the odors of the other mice stimulated him to some extent.

The mouse frequently sang as he ran about the cage, often when he was eating, or gnawing on the wires but sometimes when he was in his nest and otherwise quiet. A rather characteristic position when singing was clinging to the screen sides of the cage with his nose poked through one of the coarse meshes of the screen. On the other hand, the mouse would often run actively about in his cage without making the least audible sound; so it seems that the song could not have been due to a pathological condition of the vocal organs, as has been suggested by some authors (Barrett-Hamilton and Hinton, 1921, p. 657). At least the song was under the voluntary control of the animal.

Traces of inflammation were found in the windpipes of a number of singing mice examined by Cohen (see Barrett-Hamilton and Hinton, 1921, p. 656), and Landois found inflamed narial passages to be the cause of the song of a mouse examined by him. In both of these cases the so-called singing was apparently kept up constantly, and in the case of Landois' mouse during both inspiration and expiration. From the meager descriptions of these mice at hand it seems that their songs were not like those described for most other singing mice. A pathological condition of the respiratory tract might well cause the production of sounds, and probably the "songs" of some mice have been due to this cause. The songs of many mice, however, are, apparently under the voluntary control of the animals, and although the vocal apparatus may possibly be abnormal in structure there is no obvious diseased condition.

Many singing mice are known to have lived to a considerable age, and the male from Detroit lived for 20 months in my laboratory, and he was fully grown and known to be at least several months old when received. This would indicate a general healthy condition for many of the singing animals.

It is said by Gaumer (1917, p. 113) that in Yucatan the male mice sing at the mating period, somewhat like birds. Choruses of singing mice like those reported by this author, however, have seldom been heard by others. It is possible that the song may have some relation to sexual activity, for the Detroit singing male sometimes performed especially well when placed near others of his kind. This male sang up until the time of his death, although in his old age he seemed not to sing so frequently as when he was younger. The records in the published literature indicate that both males and females may sing.

Some observers have believed that the song of the mouse is an imitation of the song of canaries or other birds, but this seems quite unlikely to be true.

It has been noted that some mice are apparently attracted by the playing of musical instruments (Linnaeus, 1758, Tom. 1, p. 62). However, the captive male in my possession did not respond in any way to musical sounds of many different sorts produced for his benefit by the phonograph and by various instruments. This does not agree with the observation of Brehm (1883, vol. 2, p. 362) who states that singing mice are stimulated to sing by piano music.

The Detroit singing male was mated to 12 normal laboratory house mouse females kindly donated by C. C. Little. Eleven of the females proved to be fertile and a numerous progeny was reared of the first generation. Some of these f_1 offspring had a faint song, which might better be called a "chitter." The chitter may be described as a faint rapid trill, quite musical in character. It is not so musical as the song of the father, nor is it so loud. It is produced most commonly while the mouse is clinging to the wire screen of the side of the cage, with his nose through one of the meshes. At this time the nose vibrates rather rapidly and there is a rapid movement of the thorax, indicating a rapid passage of the breath through the vocal apparatus.

The mouse giving voice to the chitter shows considerable nervousness in his movements. He may keep his nose poked through one particular mesh of the screen for a number of seconds while giving his chitter, but is more likely to move about nervously, clinging to the wire screen and poking his nose through various meshes. However, the chitter may

also be produced while the mouse is feeding or is moving about on the floor of the cage.

Many of the mice assume the chitter posture on the screen sides of the cage and produce the characteristic movements without making any sound audible to my ears. There is also much variation in the loudness of the chitter produced by different animals, and by the same animal at different times, so that it is quite impossible to determine which animals lack the ability to make this sound and which merely fail to perform.

The posture and movements characteristic of the chitter are often made by laboratory house mice not related in any way to the singing strain, but I have heard only one mouse not of this strain produce any sound resembling the characteristic chitter. A male given to me by H. W. Feldman did have a hoarse, rather rhythmical chitter, somewhat similar in character but less musical than that of my animals. This animal had not been near any of the mice of my stock and could not have acquired the habit by imitation.

Matings were made between various individuals selected for chitter from among the first generation descendants of the singing male. The second generation offspring thus produced showed some improvement in the frequency of production of the chitter, but I believe the improvement to have been mostly due to a greater tameness of the mice of this generation. The mice of the first generation were quite wild. Offspring of the third and of numerous later generations, of which I bred a great number, showed no improvement in the chitter character over the mice of the second generation. It was impossible to obtain quantitative results owing to the weakness of the character and the difficulty of determining whether or not the mice really had the ability. In general if the parents were both of good chitter habit, the offspring were also of good habit.

A number of back-crosses to the original singing male were made. He was mated to his daughters from the normal females; he was again mated to his daughters from this back-cross; again to the inbred daughters of the second back-cross; and to the daughters of the third back-cross. Many of the offspring resulting from these back-crosses had the same characteristic chitter noted in the first generation, but there was no improvement due to back-crossing. These later generations were more wild than normal laboratory mice, because of the heavy percentage of wild ancestry introduced by the male, and for this reason apparently produced the chitter less reliably than the mice of the strain

which was not back-crossed. Offspring of matings between the three times back-crossed mice and the not back-crossed line, did not produce any song resembling that of the original male. The singing ability of the original male certainly was not inherited by any of his offspring. This agrees with the experience of Coburn, who failed to secure singing offspring from a singing female.

The chitter which appeared in the offspring of the original singing male is apparently not the equivalent of his song, although it may represent part of it. The chitter simulates part of his song though it is weaker in volume and less varied in pitch. The posture for the chitter is, moreover, like that which the singing male assumed frequently when singing.

In the early part of my investigation I assumed that the chitter of these mice was the equivalent of the song, being only considerably weaker in volume and less musical (Dice, 1926). I then had hopes of building up the character by selection, but many generations of rigid selection have failed to produce any perceptible improvement and the chitter of the selected stock is no nearer the song of the original male than in the second generation. The chitter character is so weak and so uncertain of determination that it is of questionable value in the study of mouse genetics. However, the remnants of my stock have been given to C. C. Little, who will continue the study.

Besides the rare song and the chitter here described, the house mouse produces a number of other vocal sounds. Most commonly heard are the scolding notes, sometimes called a squeak, often given when the mouse is fighting with another or is injured. A bird-like chirp is produced more rarely. Some individuals descended from the singing male produced a chirp occasionally, but efforts to establish by selection a strain of mice producing this sound met with failure. Mice which are in pain sometimes give voice to a rather querulous but musical warble. I have heard this sound produced by a female during parturition.

Sounds are sometimes made by mice which show no apparent evidence of injury. This was true of a female found in the cancer stocks of C. C. Little. This individual showed no evidence of cancer, but she rather constantly gave voice to a lisping and somewhat whimpering series of notes. A characteristic note is also given by very young mice. Careful studies would undoubtedly show that these small animals produce a considerable variety of normal vocal sounds, some of which denote emotional states and some of which may be used for communication with others of their kind.

It is obvious that the published descriptions of the songs of mice do not all refer to the same sort of vocal performance. Some of the so-called songs are apparently similar to the song of the Detroit male here described; other described songs are probably like the musical warble produced by some females during parturition; while still others are doubtless due to some pathological condition of the respiratory tract.

A musical song has been described by Lockwood (1871, pp. 761–770) for one of the native mice of Florida ("*Hesperomys cognatus*" = *Peromyscus gossypinus*). Hiskey (1871, pp. 171–172) has described the songs of a native deer-mouse of Minnesota ("*Hesperomys michiganensis*" = *Peromyscus maniculatus bairdii*), though there is some doubt as to the identification of this individual.

In the course of studies of variation in deer-mice of the genus *Peromyscus* I have reared in my laboratory more than eight thousand deer-mice belonging to a number of different species and subspecies. Never have I heard anything like the songs described by Lockwood and by Hiskey. In general the deer-mice are less noisy than the house mouse, but they do make several vocal sounds. A few of them produce a chitter somewhat like that produced by the house mice, but hoarser, and they assume for this purpose the same posture on the wires of the cage as does the house mouse. Some of the *Peromyscus*, like the house mouse, assume the posture for the chitter, without producing any audible sound. My attempts to produce a line of *Peromyscus* with the chitter habit, by breeding from parents selected for the chitter, have resulted in failure. The offspring usually failed to produce the sound.

A few individuals of *Peromyscus maniculatus* belonging to several subspecies have had a musical chirp, or sometimes, a rather querulous warble, but in one case the mouse had a large internal abscess, and in another case the animal had been injured in fighting. Other mice that produced the sounds were, however, apparently uninjured. Characteristic sounds are sometimes produced at the time of parturition, and possibly these notes are indicative of pain.

The males of the golden harvest mouse (*Reithrodontomys fulvescens aurantius*) when sexually excited, emit a tiny, clear, high-pitched, bugling sound (Ruth Svihla, 1930, p. 53). Harvest mice of the *Reithrodontomys megalotis* group in my laboratory sometimes gave a clear, musical trill, high in pitch and much louder than the song of the singing male house mouse which I had. It has also been shown by Davis (1927, p. 161) that harvest mice of the *R. megalotis* group are able to perceive sounds too high in pitch for the human ear to detect.

It seems possible that the house-mouse (*Mus*) and the deer-mouse (*Peromyscus*) may have a song which ordinarily is too high in pitch for our ears to hear, but which by some change in the vocal apparatus in certain rare individuals is reduced in pitch sufficiently to be audible to human ears (Sidebotham, 1877, p. 29). If this be true, it seems demonstrated that the change in the vocal apparatus is not inherited. Further studies of high-pitched sounds made and heard by these small mammals are highly desirable.

SUMMARY

Singing house mice have been recorded in many parts of the world, and both males and females have this rare habit. However, from the published descriptions, it appears that several different sorts of vocal performances have been described as songs.

The song of a male house mouse from Detroit is described. The song of this mouse was under the control of the animal and apparently was not caused by any diseased condition of the vocal apparatus.

The singing habit of this house mouse was not inherited, but a weak "chitter" which appeared in the descendents was inherited, though the character was so weak that its mode of inheritance could not be determined. A somewhat similar chitter has been found in some other domestic house mice and in some deer mice (*Peromyscus*).

A complicated song has been described as rarely occurring in deer mice (*Peromyscus*). In the related harvest mouse (*Reithrodontomys*) there is a normal, high-pitched song, and this animal can perceive sounds too high in pitch for detection by man. Perhaps the house mouse and deer mouse have a normal song of very high pitch, which song in rare individuals is lowered sufficiently in pitch to be heard by human ears.

BIBLIOGRAPHY

ABBOTT, S. L. 1847. [Account of a singing mouse in Philadelphia.] Proc. Boston Soc. Nat. Hist., vol. 2, pp. 261–262.

BARRETT-HAMILTON, GERALD E. H., and MARTIN A. C. HINTON. 1921. A history of British mammals. London: Gurney and Jackson. Part 20, pp. 649–696, illus. (Good general account of singing mice.)

BORDIER, A. 1876. Du chant des souris. La Nature, Paris, 1876, 2nd sem., pp. 415–416. (Two individuals in a house in France.)

BREHM, A. E. 1883–84. Thierleben, 2nd ed., Leipzig, 10 vols. (vol. 2, 1883, p. 362, Singing mice in Germany.)

BRIERRE, —. 1877. [Singing mice.] Nature, vol. 16, p. 558. (Summary of report by same author in Fr. Soc. d'Acclimatation. Wild mouse in house in France where no birds were kept.)

BROCKHAUSEN, H. 1901. Eine singende Hausmaus. Westfäl. Prov.-Ver., 29 Jahresber. pp. 37–38. (Germany.)

COBURN, CHARLES A. 1912. Singing mice. Journ. Animal Behavior, vol. 2, pp. 364–366. (A singing female mated to an ordinary male gave birth to 33 young, none of which inherited the character.)

1913. Singing mice. Journ. Animal Behavior, vol. 3, p. 388. (Suggestion made that "singing" occurs only in females.)

1922. Heredity of wildness and savageness in mice. Behavior monographs, vol. 4, no. 5, pp. iv + 71.

COLLINS, JOHN. 1849. Whistling mouse. Zoologist, London, vol. 7, pp. 2474–2475. (England.)

COUES, ELLIOTT. 1872. More about singing mice. Amer. Nat., vol. 6, pp. 309–310. (Singing male white mouse reported; offspring did not have the characteristic.)

——— 1888. Rodentia. *In:* Riverside Natural History, edited by J. S. Kingsley. Boston and New York; Houghton, Miffiin and Co., vol. 5, pp. 68–133. (p. 109: song of house mouse.)

DAVIS, ALONZO C. 1927. Sound perception in a harvest mouse. Journ. Mammalogy, vol. 8, pp. 161–162. (*Reithrodontomys megalotis longicaudus* able to hear sounds too high in pitch for human ear.)

DAVIS, WILLIAM T. 1889. The song of the singing mouse. Amer. Nat., vol. 23, pp. 481–484. (House mouse; locality not stated. Song loudest and most continuous when running about, gnawing or eating. Sang most continuously at time of birth of young.)

DICE, L. R. 1926. Inheritance of the singing habit in the house mouse. Abstract. Anat. Rec., vol. 34, p. 171.

EDWARDS, W. H. 1870. A singing mouse. Amer. Nat., vol. 3, pp. 551–556. (In New York State)

ENGLISH, DOUGLAS. 1909. One hundred photographs from life of the shrew-mouse, dormouse, house-mouse, field-mouse, meadow-mouse, and harvest-mouse, with notes and observations. London, etc.; Cassell & Co., Ltd., pp. 95. (pp. 84–85: Singing house mice in British Isles. Sometimes a chorus in conservatory where they occurred. "The sound when 3 or 4 mice sing together, but out of time, is ludicrous.")

FARR, JOHN. 1857. Singing-mouse. Zoologist, London, vol. 15, p. 5591. (In Suffolk, England.)

FRY, HOWARD. 1865. Singing mouse. Zoologist, London, vol. 23, p. 9432. (England.)

GAUMER, GEORGE F. 1917. Monografía de los mamíferos de Yucatán. Mexico City; Secretaría de Fomento, Dept. de Talleres Gráficos, pp. 41 + 331. (pp. 113–114: Singing mice in Yucatan.)

GOULD, A. A. 1851. [Account of a singing mouse caught in Boston.] Proc. Boston Soc. Nat. Hist., vol. 3, p. 4.

HEGNER, R. W. 1917. Singing mice. Amer. Nat., vol. 51, p. 704. (In Michigan.)

HISKEY, W. O. 1871. Singing mice. Amer. Nat., vol. 5, pp. 171–172. (Account of song of mouse in Minnesota which might have been a house mouse, but which appeared like a *Hesperomys michiganensis*.)

HUGO, LE COMTE. 1877. [Singing mice in China.] Bull. Soc. Zool. France, vol. 2, p. 87. ("...Dit avoir entendu raconter par M. l'abbé David que, dans ses voyages en Chine, il avait vu des souris conservées en cage comme animaux d'agrément, à cause de leur chant.")

JOHNSTON, HARRY HAMILTON. 1903. British mammals; an attempt to describe and illustrate the mammalian fauna of the British Islands from the commencement of the Pleistocene period down to the present day. London: Hutchinson & Co. pp. xvi + 405. (p. 243: Singing mice in Tunis and England.)

[LANDOIS, H.]. 1883. [Singende Mäuse.] Jahresbericht des Westfälischen Provinzial-Vereins für Wissenschaft and Kunst, vol. 11, pp. 17–19. (In Germany.)

——— 1883. [Eine singende Maus.] Jahresbericht Westfälischen Provinzial-Vereins f. Wiss. u. Kunst, vol. 11, pp. 21–23.

LATASTE, M. F. 1877. [Sur le chant des souris.] Bull. Soc. Zool. France, vol. 2, pp. 85–87.

——— 1877. Sur le prétendu chant des souris. Act. Linn. Soc. Bordeaux, vol. 31, pp. 239–240. (Criticism of Bordier, 1876; thinks he may have heard an amphibian, *Bombinator*, instead of a mouse.)

LATASTE, FERNAND. 1886–1889. Documents pour l'éthologie des mammifères. Première série. Notes prises au jour le jour sur différentes espèces de l'ordre des rongeurs observées en captivité. Actes Soc. Linn. Bordeaux, vol. 40, pp. 293–466; vol. 41, pp. 201–536; vol. 43, pp. 61–208. (vol. 41, pp. 311–313: Expresses doubts about songs of mice.)

LINNÉ, CARL VON. 1758. Systema naturae. Ed. 10, vol. 1, p. 62. (*Mus musculus:* "Delectatur musica.")

LOCKWOOD, SAMUEL. 1871. A singing Hesperomys. Amer. Nat., vol. 5, pp. 761–770.

MERRIAM, CLINTON HART. 1884. The mammals of the Adirondack region. New York, pp. 316. Reprinted from vols. 1 and 2, Trans. Linn. Soc. New York. (Pp. 261–262: Records of singing mice in Michigan and Virginia.)

[NEWMAN, EDWARD]. 1843. Note on a singing mouse. Zoologist, London, vol. 1, p. 288. (In London.)

NEWMAN, E. 1865. [Singing mice.] Zoologist, London, vol. 23, p. 9432. (Thinks singing mice afflicted with some lung disease, perhaps tubercular phthisis, or that infirmity which in horses is called "whistling.")

POWERS, EDWIN B. 1925. The singing of the house mouse. Jour. Mammalogy, vol. 6, p. 201. (In Tennessee.)

ROMANES, GEORGE J. 1877. Singing mice. Nature, vol. 17, p. 29. (London, England. A number of singing wild mice in house in which no birds had been kept. Sang normally in evening, but in daytime if disturbed.)

SETON, ERNEST THOMPSON. 1909. Life histories of northern animals; an account of the mammals of Manitoba. New York City, C. Scribner's Sons, 2 vols. (vol. 1, p. 482: Singing house mouse in New York.)

SHUFELDT, R. W. 1900. Chapters on the natural history of the United States. New York; Studer Brothers, pp. 472 + 8. (p. 420: A female house mouse "sang" while giving birth to young.)

SIDEBOTHAM, JOSEPH. 1877. Singing mice. Nature, vol. 17, p. 29. (France. Suggests that normal song may be too high in pitch for human ear to hear.)

SLATER, HENRY H. 1877. Singing mice, Nature, vol. 17, p. 11. (England. Song not inherited.)

STINDE, JULIUS. 1881. Das Räthsel der singmäuse. Deutsches Familienblatt, Berlin, no. 46, Nov. 13. [Not seen by me.] (Quotes Dr. Cohen of Hamburg as having examined a number of singing mice and of finding a diseased condition in the wind-pipes of all. These mice produced the song only during inspiration. They were unhealthy and lived only a short time in captivity. From quotation by Struck, 1882.)

STRUCK, C. 1882. Eine singende Maus. Archiv. Ver. Freunde Naturg. Mecklenburg, Jahrg., 55, pp. 117–118. (Germany. Lived in captivity 7 months.)

SVIHLA, RUTH DOWELL. 1930. Notes on the golden harvest mouse. Journ. Mammalogy, vol. 11, pp. 53–54, (*Reithrodontomys fulvescens aurantius* in Louisiana.)

WOOD, J. G. 1885. Animate Creation; popular edition of "Our living world," a natural history by the Rev. J. G. Wood; revised and adapted to American Zoology by Joseph B. Holder, New York; Selmar Hess. 3 vol., illus. (vol. 1, p. 458: Singing mice in England.)

University Museums, University of Michigan, Ann Arbor, Michigan.

MAMMALS COLLECTED OR OBSERVED IN THE VICINITY OF LAURIER PASS, B. C.

BY W. G. SHELDON

The following notes comprise a condensed account of the mammals collected and observed by Richard Borden and myself in northern British Columbia during the summer of 1931. The paramount object of our trip was to collect specimens of mountain sheep north of the Peace River in the vicinity of Laurier Pass in order to determine if the characters observable in the five sheep collected there in 1912 by Mr. F. K. Vreeland were consistent enough to warrant the description of a new subspecies showing intergradation between *Ovis stonei* and *Ovis canadensis*. Our sheep investigations necessitated continuous traveling and hunting, thus leaving but little time for the preparation of the smaller mammals.

Accompanied by one assistant, W. S. Keily, we set out with horses from Hudson Hope on the Peace River on June 27, returning there on

September 13. We started out by following the Peace west to the mouth of Aylard[1] ("twenty-mile") Creek flowing in from the north; this is about 50 miles east of the junction of the Findlay and Parsnip Rivers. From here our route roughly lay north along the eastern flank of the main range across Laurier Pass to the headwaters of the Prophet River, 200 miles north of the Peace. The divide between the northern banch of the Halfway River and the southern branch of the Sikanni Chief River marks the separation of the watersheds of the Peace and Liard Rivers. On our return we retraced our route to Laurier Pass, whence we turned east to the lower country lying just north of Hudson Hope. We frequently penetrated the mountains well to the westward in quest of sheep.

With the exception of one bat every specimen we collected was taken in the mountains at an altitude varying from 4,000 to 7,000 feet. Perhaps the most surprising observation recorded all summer is the total lack of any species of ground squirrel (*Citellus*), or pika (*Ochotona*) in the entire region traversed. Both genera occur in the mountains north of the Canadian National railway in Alberta, and also in the Yukon Territory, but the exact limits of their ranges seem to be undetermined.

I intend to present a detailed account accompanied by photographs of the entire trip at a later date, but am publishing these notes now with the hope that they may aid North American mammalogists to fill in gaps on their distribution maps. Any additional information concerning the mammals of this region will be most welcome for my own records.

LIST OF SPECIES COLLECTED OR NOTED

Ovis stonei.[2]—Stone Mountain Sheep. The final report on the range and status of the Laurier Pass sheep must await further investigation. I shall take this opportunity to briefly set forth such progress as we made last summer in an endeavor to solve the problem.

Coupled with our intention of discovering if the Laurier Pass sheep consistently bear resemblances to the heavy-horned *Ovis canadensis* was our desire to trace the northern range of these sheep as far as possible and attempt to ascertain whether they merge with the slender-horned *Ovis fannini*. It was essential, therefore, to obtain specimens not only from the country lying between Peace River and Laurier Pass but from as far north as possible. The southernmost specimen secured was a mature ram shot on July 7 at the head of Nabesche ("Ot-

[1] The place names given throughout this report have been adopted from the official government map of this area which is obtainable at the Department of Interior in Ottawa. It is called the "Hudson Hope" sheet, No. 94 S. E.

[2] Not typical.

tertail") River, 28 miles north of the Peace River. The most northern sheep obtained was another large ram secured August 24, north of the headwaters of the Prophet River. The remaining specimens—5 rams and 1 ewe—were secured at locations between these two points. These sheep, as well as all the remaining material we collected, are available for study at the National Museum in Washington, D. C.

At present I shall not discuss in detail the color and horn formations of these sheep nor attempt to describe in what respect they resemble *Ovis canadensis*; suffice it to say that both the horn formation and color varied considerably in the sheep observed. For example, the darkest ram collected was the most northern one, but he was accompanied by 9 other rams, among them the lightest I observed all summer, one of which might easily have been referred to *Ovis fannini*.

During the entire summer we counted 348 sheep, of which 92 were rams and the rest ewes and lambs. The sheep were most plentiful from Keily Creek north to the Prophet River. There was a surprising number of ewes without lambs. Although many bands were too distant for us to count accurately the percentage of lambs, five separate small bands with a total of 35 ewes did not have a single lamb. In the large bands the small number of lambs was always very noticeable. The exact cause for such a condition can only be ascertained from further study.

Every sheep collected showed traces of a jaw disease that in many cases had so distorted the bone that most of the teeth were gone. In some rams it was actively at work, since I found pus inside the swollen jaws. Mr. A. Bryan Williams, Game Commissioner of British Columbia, writes me that he has seen the same disease among the Cassiar sheep, but all the animals he shot had recovered from it. I doubt very much if it diminishes their numbers; at the most it may shorten their lives a year or two because of loss of teeth. In most cases it seemed to have taken the greatest effect on the lower jaws.

Oreamnos americanus columbiae.—Mountain Goat. Goats proved to be very local in their distribution. On certain mountains they could be found at any time while other ranges seemed to harbor sheep exclusively. I have a reliable record of goats ranging as far south as the banks of the Peace. We observed the first goat in Laurier Pass, and the most northern ones just north of Keily Creek. About 50 were counted in all; they were most abundant on the mountains dividing the south fork of the Sikanni Chief and the Ospika River. In a region such as this, where little hunting has been done, the stupidity and sluggishness of the goat offered a marked contrast to the alertness and wildness of the sheep.

Bison bison athabascae.—Wood Bison. It was comparatively only a few years ago that the last bison disappeared from the country north of Hudson Hope. We found and photographed an old skull on Cypress Creek and saw others which have been picked up in recent years. Alexander Mackenzie tells in his diaries of vast numbers of bison and elk seen along the Peace during his expedition in 1795.

Alces americana.—Moose. We observed 11 moose during the summer; 4 of these were exceptionally large bulls. It is, of course, very difficult to judge the size of an animal's body and horns when he is alone, but we observed these bulls at quarters close enough to make us wonder if this species might not be more closely related to the Alaskan moose than to the smaller mountain moose of the southern country. Moose range over the entire country from the Peace to the Prophet River.

Rangifer osborni.—Osborn Caribou. In early July a large male caribou was observed in Laurier Pass; this was the first one seen and the only one south of Robb Lake and the northern branch of the Halfway River. After we crossed the latter river just east of Robb Lake, we found the area most frequented by caribou. From here north as far as we went proved to be the natural caribou range. One mature bull was collected at the head of the Sikanni Chief River on August 31st; the rut does not begin until the middle of September; I saw one bull with six cows, but all others observed were either in separate bands of cows and calves or bulls. Approximately 40 caribou were counted, and the largest herd contained 9. Natives say they are not very migratory in their habits and that they remain on practically the same territory summer and winter. Although we often saw their tracks high on mountains in the sheep country, they remained for the most part on the high barren plateau-like mountains that fringe the eastern side of the main range. The hunting by Indians has been a telling factor in their decrease, but at present I believe the Indians are disappearing so rapidly that the caribou will never be exterminated by them.

Cervus canadensis canadensis.—Wapiti. I have reliable evidence that an isolated band of wapiti exists in the valley of the Musqua River, northwest of the Prophet. I have spoken with several trappers and surveyors who have seen the animals and killed them for meat. Mr. A. Bryan Williams informs me he has known of their existence for some time. They range at least to the Liard River, and I have reports of their existence north of this river. Although they have vanished from Peace River valley, it is not an uncommon thing to pick up an old antler; we saw one of these at Hudson Hope.

Odocoileus hemionus.—Mule Deer. Deer are quite plentiful in the Peace River valley itself but scarce in the mountains. One doe was seen on Keily Creek and three large bucks north of the Prophet River; these were the only deer we saw north of the Peace.

Lepus americanus americanus.—Snowshoe Rabbit. One specimen of the snowshoe rabbit was taken on Aylard Creek on June 29, when its pelt had not yet entirely changed to its typical summer brown. Although last summer was certainly not a year when the rabbits had reached their seven-year maximum in numbers, they were not scarce, and their trails were found almost everywhere.

Sciurus hudsonicus hudsonicus.—Northern Red Squirrel. Ten specimens of red squirrels were secured at different places along our route from Aylard Creek to Redfern Lake; although none were taken north of this lake scarcely a day passed when we did not see them. I recorded one interesting observation as to the habitat of this species; during the summer months in the mountain country, they seem to frequent largely the lodgepole pine groves; since this pine does not grow at as high an altitude as the spruce, we often had camps at high levels where these squirrels were very rare; in the two weeks spent in Laurier Pass but one male red squirrel was seen; likewise in our first camp at the head of Sikanni Chief River, where we spent a week, I heard only one. In both these camps there was no lodgepole pine in the immediate vicinity. They must feed on the spruce cones later in the season, but we found their chief summer diet to be the tender, sweet, inner layer of tissue lying just under the outside bark of the lodgepole pine. I observed them often gnawing away the outside bark to reach the inner layer, and in many cases they had ringed the tree near the top, thus accounting for many dead tops.

Although we had at first attributed this to porcupines our observations convinced us the squirrels were responsible.

Eutamias minimus borealis.—Northern Chipmunk. This chipmunk was the commonest mammal observed in the mountains all summer. It seemed equally at home skipping along the fallen timber in the forested valleys or darting among the rocks high above timberline. Scarcely a day passed when we did not see several of these familiar little mammals. Of the 5 specimens collected, one was taken as far south as the head of Nabesche River, and the most northern specimen on the Sikanni Chief River.

Marmota caligata oxytona.—Robson Hoary Marmot. As in most of the western mountains the long mellow whistle of the hoary marmot was the most familiar sound heard above timberline. We shot only two specimens, but the animals were observed on every mountain we hunted from the head of Needham Creek to the last mountain climbed north of Prophet River.

Neotoma cinerea drummondi.—Drummond Wood Rat. Almost every abandoned trapper's cabin was occupied by pack rats. The first rat was observed high above timberline in Laurier Pass. The five specimens we trapped were taken among a large jumble of boulders at timberline high on a slope north of Robb Lake. There were many caves and declivities under the rocks, forming an ideal abode for these rats. The whole place reeked with their characteristic odor. Mouse sign proved so abundant in the same place that we set a dozen small traps, all of which were abducted by the rats before morning. I believe they range at least as far north as we went—on the Prophet River and very likely as far as the Liard. They are very abundant in the lower country east of the mountains, and many are killed every year at Hudson Hope.

Peromyscus maniculatus borealis.—Northern White-footed Mouse. Of all the mice trapped, we found the white-footed mouse frequenting the most varied habitat. I captured three high above timberline on the bare open rock-strewn slopes some distance away from the nearest cover of willows or ground evergreen. I caught one in my hands at 7,000 feet as it was running along high up on an open pass several hundred feet from the nearest cover—there were not even rocks large enough to conceal it. Of course, they proved to be one of the commonest mice at all lower altitudes. We saved specimens from almost every camp from the Graham River to Richards Creek. In all 24 were taken.

Clethrionomys gapperi athabascae.—Red-backed Mouse. The first of the 24 red-backed mice which we prepared was trapped at the eastern end of Laurier Pass under the low branches of a large spruce tree. These mice were not found inhabiting as varied a topography as the white-footed mice. They confined their habitat to the wooded valleys and none were seen above tree-line. We traced their range as far north as Keily Creek.

Lemmus helvolus.—Tawny Lemming. The seven lemmings we secured were all taken in Laurier Pass. One female with 6 embryos was caught July 17, about two miles north of the Pass, and all the others were trapped on Cypress Creek summit at the eastern end of the Pass. Although they proved to be most abundant in this immediate vicinity, I observed one well-populated colony on the divide between the headwaters of Sikanni Chief and Ospika Rivers. They seem to prefer grassy slopes and passes above timberline at about 6,000 feet altitude.

Microtus pennsylvanicus drummondii.—Drummond Meadow Mouse. The

first meadow mouse was trapped at the head of Nabesche River in July; 22 others were captured at intervals from there north across Laurier Pass to the Sikanni Chief River. Although these mice seemed to prefer the wet, grassy river bottoms, we found them at and above timberline in localities where there was a rich growth of grass.

Microtus mordax mordax.—Cantankerous Meadow Mouse. A young specimen of this species was taken on Sikanni Chief River on September 3.

Castor canadensis canadensis.—Beaver. Beaver occur with varying frequency. The Indians usually make short work of a beaver colony.

Erethizon epixanthum nigrescens.—Dusky Porcupine. The well-known porcupine of the North was fairly common throughout all the region we traversed. We saved one skull from Laurier Pass and another from Robb Lake. One that Keily killed in Laurier Pass was a partial albino.

Zapus princeps.—Jumping Mouse. Ten jumping mice were taken at Laurier Pass and on the south fork of the Sikanni Chief River. I often observed them among the high willows in the river bottoms or at tree line.

Felis concolor.—Mountain Lion. There are three records of mountain lions having been killed by Indians in the Graham River valley north of the Peace River in the last decade; the authenticity of these reports was confirmed by all the natives. James Beattie, a trustworthy Englishman who lives at the mouth of Aylard Creek on the Peace River, says that within the last few years he has found tracks of three lions in the snow of early spring on the bluffs above his ranch.

Vulpes alascensis abietorum.—British Columbia Red Fox. Trappers assert that some years are far more fruitful in the yield of fox pelts than others. We found one fox skull on the Sikanni Chief River; and another was taken from a dead "cross" fox found near the trail at Horseshoe Creek. Since apparently he was not injured externally, he must have been poisoned; unfortunately his skin was too far decayed to save.

Canis occidentalis.—Northern Gray Wolf. We first observed wolf tracks just north of Laurier Pass, and occasionally saw others along our route to the Prophet River. Wolves occur in greater numbers just south of the Peace.

Mustela cicognanii.—Bonaparte Weasel. A male and a female weasel were collected during the summer, and one other was observed swimming across Richards Creek. The male was taken at the head of the Sikanni Chief River, and the female was trapped in a lemming runway at the eastern end of Laurier Pass; we were very interested to find that she was carrying an immature lemming in her mouth. That she probably was taking it to a litter of young was evidenced by the fact that her teats still contained a little milk, showing she must have very recently weaned her offspring. Since these little weasels can follow a lemming in any of its runways under grass hammocks or into their holes, they must prey on these rodents extensively wherever they exist in any numbers.

Mustela vison energumenos.—Northwestern Mink. Mink are not common but are occasionally taken.

Martes americana actuosa.—Alaska Pine marten. The marten seems to yield the trapper his largest harvest of pelts every year.

Martes pennanti pennanti.—Fisher. Fishers are not common but are occasionally caught.

Gulo luscus.—Wolverine. We did not see any wolverines all summer but picked up one skull at Keily Creek. That the trappers and Indians respect the "carcajou's" skill in raiding stores of provisions is attested by the many caches constructed well out of his reach.

Ursus pellyensis.—Pelly Grizzly Bear. In addition to the skull of a young male obtained from Keily, two complete specimens of grizzlies were collected—a mature male and a female. The latter was procured July 6, at the head of Needham Creek, only 30 miles north of the Peace; she was accompanied by a small, dark-colored cub. The former was taken on August 11, just west of Redfern Lake, almost 100 miles north of where the female was obtained. Although only one other bear, an individual observed on the Prophet River in late August, was seen the entire summer, fresh sign was abundant on all the mountains, and judging from reports grizzly bears are fairly plentiful from the Peace to the Liard. It is not uncommon to find them in the low valleys of the Peace away from the mountains, but the natives report their growing scarcity.

The total lack of ground squirrels in this region compels the grizzly to be satisfied with a more strictly vegetarian diet. The stomachs of the ones secured contained, besides quantities of unidentified vegetation, the remains of one meadow mouse. I frequently came across dung, none of which seemed to contain any animal remains whatsoever. They must occasionally capture a marmot or chipmunk, but these mammals usually inhabit impenetrable rocky recesses where successful digging is impossible. The male grizzly I shot was clambering over cliffs high above timberline at the head of a basin; the short length of his claws showed they had been worn down by continual hunting above tree line. Trappers say that in early summer the grizzly travels a great deal among the rock slides along the fringes of steep slopes in search of the carcasses of sheep or goats, which often are killed in the snow avalanches of early spring.

Euarctos americanus.—Black Bear. In a two-day hunt for black bear in the Peace River valley we failed to secure a specimen. They can usually be seen in a good berry year coming down to the banks of the Peace to feed in the evenings. They scarcely ever penetrate the mountain region to encroach on the mountain domain of the grizzly but confine their range to the low country. Their tracks were plentiful not only on the shores of the Peace but on all the islands.

Myotis keenii septentrionalis.—Northern Little Brown Bat. I was disappointed not to be able to secure more than one specimen of this little bat, but except for the one collected at Hudson Hope, they were observed only once during our trip; these were distinctly observed at dusk in a grove of poplars just north of the head of the Prophet River at our northernmost camp.

Sorex obscurus obscurus.—Dusky Shrew. This summer turned out to be an exceptionally favorable one for the trapping of both mice and shrews. Had we taken more traps and devoted all our time to small mammals, we could have been busy every moment. The little dusky shrew was one of the most abundant; they occupied our traps in most of our camps from Laurier Pass north to Redfern Lake. Ten specimens were saved. Like the white-footed mouse, this little shrew occurred at all altitudes. I captured one high on a grassy bench of a rough and precipitous mountain side at the very moment I was watching two large mountain rams lying 200 yards below me. After a light snowfall I observed many tracks of these shrews among the rocks on the very mountain peaks—several hundred feet

above the nearest vegetation. I frequently found a species of large spider inhabiting this kind of rock formation and I wonder if these insects may not provide the shrew with a substantial summer diet at such altitudes.

Neosorex palustris navigator.—Water Shrew. The water shrew was the rarest of all the mammals collected. Only one specimen was secured the entire summer; this was trapped in September at the head of the northern branch of the Halfway River about 10 miles north of Laurier Pass. One other was observed swimming across Aylard Creek 10 miles north of Peace River.

New Haven, Connecticut.

NOTES ON MAMMALS OF MENOMINEE INDIAN RESERVATION, WISCONSIN

By E. V. Komarek

The following notes are based on a preliminary mammal survey of the Menominee Reservation in northern Wisconsin, made for the Chicago Academy of Sciences during the summer of 1929.

The Menominee Reservation, consisting of 231,000 acres in Shawano and Oconto counties, Wisconsin, is probably one of the largest timbered tracts left in the state. There are about one billion feet of standing timber in which large mammals, once abundant in Wisconsin, are still not uncommon. The northern part of the reservation is heavily wooded, much being virgin timber and mostly hardwoods, although there are good stands of conifers in certain areas. At present, this section is uninhabited except for several families living at the Neconis and South Branch Settlements, and an occasional farmer. There are few roads and they are well nigh impassable with automobile, except the gravelled state highway which borders the Wolf River. The southwestern section is also wooded, but with smaller timber, and is likewise unsettled except along the boundary where the Stockbridge Indians live.

The Indian villages of Neopit and Keshena are located in the southeastern border. A highway connects these towns and extends westward farther into the state. This highway and the one following the Wolf River are used to a large extent by tourists, and much of the adjacent land has been cleared or cut over. To the east of Keshena is a region where, in an area some nine miles square, twenty five lakes are located. This portion is cut over, or is prairie land with an occasional small remnant of woods surrounding a lake. Much of this area is low and

undrained, and thus furnishes an excellent habitat for the muskrat, which is very abundant. The Wolf River winds its way through the eastern half of the reservation and provides a splendid habitat for otter and muskrats, while along its shores skunks, minks, and the larger furbearers are to be found. Along many of the spring-fed trout streams that enter the Wolf River, beavers are found. This area, in a certain sense, has become a natural game refuge, as the Indians do very little hunting or trapping, consequently, mammals are abundant. Bears and deer are very common, probably more so than in any other part of the state.

I wish to thank the Indian Bureau for giving me permission to make this survey. To Mr. W. Beyers and to the Menominee Indians, particularly Chief Reginald Oshkosh, I am indebted for their hospitality and kind assistance, without which this work would not have been possible.

Condylura cristata.—Star-nosed Mole. A specimen of this mole was trapped in an open stretch near Keshena, Wisconsin, on July 21, 1929. Another was found dead in the woods near Neopit in September. These moles have a distinct musky odor that is very evident when one is skinning them. Their tunnels, which were made in the pine mats and occasionally in sphagnum moss, were commonly seen in the low timbered districts. They resembled the runways of *Blarina brevicauda* but were larger and had more of a surface ridge which had occasional breaks in it.

Sorex cinereus cinereus.—Common Shrew. These little shrews are common in the cut-over and timber districts, and several were collected in July and September, 1929. I was fortunate one day in being able to observe one hunting for his food. He was very lively, scampering at random and poking under the leaves and twigs. Most of his travelling was about an old rotted stump that had a meager clump of grass at its base. It was in this grass, after a few minutes of searching, that the shrew discovered a large grasshopper and quickly killed it. After eating nearly all of his victim, which was almost his own size, he started hunting again. The little fellow kept his nose close to the ground while running, and occasionally stopped and lifted his head and fore part of his body to look over a leaf or twig. He did not follow any evident runways or tunnels, but seemed to go wherever fancy led him. During most of the time he was under observation, about ten minutes, he kept up a twittering of short, high-pitched squeaks, only stopping long enough to get a grub or other insect. After capturing and eating a large ground beetle (*Calosoma*), he disappeared in the stump.

Blarina b. talpoides.—Short-tailed Shrew. These shrews are very common everywhere on the reservation, and are generally called moles by the Indians. They are especially common in the pine districts, where they have numerous tunnels near the surface of the pine mats. I also found them abundant at the base of old fence posts that were in a state of decay. I usually trapped two adults and two or three half grown immatures at each post. Immatures were trapped in July, August, and September. They took readily to peanut butter as bait, and even more so to the flesh of their own species.

Lynx rufus.—Bobcat. The Indians report bobcats as fairly numerous, and I examined one that had been taken on the reservation within a few years. Peter Nabascum, an Indian trapper, said he trapped one in the winter of 1926. Charles Westcott, also a native trapper, reported that they were common during the winter, and that he had seen them during the day in the northern section of the reservation.

Lynx canadensis canadensis.—Lynx. Rob Lyons informed me that he trapped one in the winter of 1928, and sold it to a fur trader. This is the only record of one taken that I was able to find, although many of the trappers report that there are a few left.

Canis latrans.—Coyote. I heard several, and the Indians report them to be very common. They get several each year, as there is a bounty on them. An Indian trapper, J. Witney, who lives at Burnt Shanty Rapids, is reported to be making his living trapping coyotes for the bounty. As the northern section is wild and unsettled, they are undoubtedly common.

Canis nubilus.—Wolf. A few are shot or trapped each winter in the heavily timbered districts, and during the severe winter storms they occasionally travel along Wolf River to the vicinity of Keshena. They are said to be numerous in the northwestern section, but, as there is a heavy bounty on them, they are being killed off. A large one was seen in a cedar swamp about two miles north of Keshena. It was supposed to live in and around the swamp all the year, and had thus far evaded the lures of the trappers.

Urocyon cinereoargenteus.—Gray Fox. The native trappers take several every year, but I was not able to see a specimen taken on the reservation. It may be the northern form.

Vulpes fulva fulva.—Red Fox. The Indians catch several each year, and report them to be more common than the gray fox. I saw several skins that had been taken within the last few years. All phases from red to black are trapped. Rob Lyons saw a black fox which stayed in the vicinity of his cottage on the shore of Big Sand Lake for two days in the fall of 1927. It was seen several times near his cabin.

Procyon lotor lotor.—Raccoon. Raccoons are common and many are taken by the native trappers each winter. I saw two live immature specimens that Rob Lyons had trapped at Sand Lake. They are quite frequently seen along the roads at night, but are not as numerous as the tourists think, for it is my opinion that, in the faint light from the cars, they mistake the porcupine, which is very common, for the raccoon.

Lutra canadensis canadensis.—Otter. Otters are numerous along the rivers and creeks throughout the reservation. They are found also, though not so abundantly, along the lakes in the southeastern section. Many are trapped each year. Mr. W. Penass of Keshena killed an adult and four young at Keshena Falls in August, 1928. Rob Lyons said that there were two playing on the shore of Sand Lake every morning in the latter part of August, 1929. I saw one several times, just above the Keshena Falls dam. The dam had been raised about one foot, and as this raised the level of the river back of the dam, I think this fellow was forced out of his den and had to move, for I saw him several times late in the morning. I also found a slide about a quarter of a mile above the falls, on the east side of the river.

Mustela vison.—Mink. The Indians report them common along Wolf River and on the lakes in the southeastern section. They are trapped extensively by the natives who start taking them as early as the first of October.

Mephitis hudsonica.—Hudsonian Skunk. Skunks are reported to be very numerous throughout the reservation. I saw two adults and one young that had been caught on August 19, 1929, near Keshena Falls.

Taxidea taxus.—Badger. Bob Deer, of Keshena, said he found a frozen badger in the winter of 1926, near Keshena Falls. Rob Lyons told me that he catches several each winter. Charles Westcott said there are a few around the Crow Settlements.

Euarctos americanus.—Black Bear. The black bear is numerous in most parts of the reservation, many being trapped or shot by the Indians each year. I saw a large one at the old La Belle farm in the northeastern part of the reservation, on September 11, 1929, and tried to collect one at the Neconis Settlement on September 30, 1929. The one at the La Belle farm was seen at noon from an auto, and as soon as I stepped out of the car it slowly loped into the brush on the edge of the clearing. The other one visited an old deserted apple orchard every night. Mr. F. Kaka of Keshena caught three adults in the winter of 1928. Rob Barnes saw an adult and a cub on route 55, just north of Keshena, on August 2, 1929. Rob Lyons and another Indian captured three adults between September 20 and 25, 1929. The majority of those taken each year are trapped. The Indians build a tent-like affair of bark, and in the end opposite the entrance a small can of honey is placed, in front of which is a large log. The trap is set so that when the bear enters the enclosure to get at the honey, he puts his foot into a steel bear-trap. During the winter months the meat is said to be sold for as low as twenty cents a pound. Many of the Indians will not eat bear meat, for, as one of the Indian squaws expressed it, "I wouldn't dirty my pots and pans with it."

Glaucomys sabrinus macrotis.—Flying Squirrel. Although I did not secure any specimens, these pretty little creatures are not uncommon on the reservation. Mrs. Reginald Oshkosh had four young as pets, and other Indians mentioned having recently caught adults.

Sciurus niger rufiventer.—Western Fox Squirrel. This large squirrel has been hunted so intensively that it has become scarce in recent years. I saw only one, which was on the plains in the southeastern part of the reservation, on October 1, 1929. Squirrels in general lead a precarious life in the more settled parts, as the Indian boys, equipped with modern guns, delight in hunting them.

Sciurus carolinensis leucotis.—Northern Gray Squirrel. The gray squirrel was common only along the beech ridges, where it was abundant. These squirrels are much more timid than the chickaree, as they are hunted by the Indians for food. Several were collected in October, just as the pelage was changing. Some were still in the summer coat, while a few had the thick winter fur. The Indians report a few black ones, but say that they are less abundant than in the past. Charles Westcott, of Keshena, shot one at Neopit, Wisconsin, in October, 1928. I examined one that had been used to make a medicine bag.

Sciurus hudsonicus minnesota.—Chickaree; Red Squirrel. This cheery little fellow is found everywhere on the reservation, but seems to prefer the pine and beech ridges. I found them very abundant around the sugar camps, which were situated in large stands of sugar maples. They are used to some extent as food

by the Indians, but not so much as the gray or fox squirrels. Specimens were collected in August, September, and October. During the early part of October they were commonly seen snipping off pine cones, a feat that they did very dexterously.

Tamias striatus lysteri.—Lyster's Chipmunk.—The deep chuck and shrill whistles of these chipmunks are commonly heard everywhere in the woods of the reservation. They are especially abundant in the stands of large beeches, where they have their nests under old stumps. These lively little fellows are not hunted, so they are very tame. Those around the refreshment stands will sometimes take food from one's hand. A nursing female was collected in July, 1929.

Eutamias minimus jacksoni.—Lake Superior Chipmunk. On July 19, 1929, I caught one of these beautiful little animals alive. It made no attempt to bite, and seemed to enjoy eating peanut butter. These chipmunks are not common, but they can be seen occasionally at the lumber yard at Neopit, or around the shores of Big Sand Lake.

Citellus tridecemlineatus tridecemlineatus.—Thirteen-lined Spermophile. The striped ground squirrel is found only in the cleared portions of the reservation, where it is quite common, although not numerous enough to cause any damage to the crops. Adults and half-grown young were collected in July, 1929.

Marmota monax rufescens.—Woodchuck. Throughout the reservation these mammals, which are esteemed as food by the Indians, are numerous. They prefer the southeastern section, as it is less wooded, and has a sandy or gravelly soil.

Castor canadensis canadensis.—Beaver. On July 24, 1929, I saw a large beaver dam at the outlet of McCall's Lake, in the northern part of the reservation. It was about 250 or 300 feet in length and from one to five feet in height. It raised the level of the lake about five feet. About two-thirds of the dam is several years old; aspen saplings and a thick growth of weeds nearly cover it. The Indians say that it is about five years old, and was started by beavers that had been driven down by floodwaters and the breaking of a large hydraulic dam in northern Wisconsin. In the section where it is five feet high it has been dynamited by the Indians, as it frequently causes the waters of McCall's Lake to flood the logging road. This damage to the dam has not disturbed the beavers much, for they quickly patch up the hole. At present, a six-inch log, covered up by about a foot of mud, twigs, and lily pads, is lodged across this section. The lake side of the dam is covered with mud, lily pads, and roots. The outlet is surrounded by aspens and beeches averaging about one and one-half inches in diameter. Only the aspens were found to have been cut. On the south side of the dam there are two well-developed slides where the beavers have dragged saplings they had cut on shore. On July 24, 1929, fresh beaver cutting and one adult beaver were seen along the Evergreen River. Some of the cuttings near camp 128 are four inches in diameter. An adult beaver was killed and eaten by the Indians at the Dells of the Wolf River, on September 22. According to the Indians, the beavers have increased greatly in numbers, and have moved into the southern portion within the last five years. The Indians report five dams on the reservation, but I was only able to get reliable information about three—the one at McCall's Lake, one on the south branch of Wolf River, and one on the Little West Branch River.

There is very little trapping for pelts, as the Indians can not sell them to anyone, and they rarely kill any for food.

Mus musculus.—House Mouse. I found the house mouse only around the refreshment stands, and around the towns, but never at a great distance from human habitation.

Rattus norvegicus.—Norway Rat. This rat is much more common than the house mouse, and infests the refreshment stands, where it commonly carries away whole bars of candy. It is undoubtedly the most destructive mammal on the reservation.

Peromyscus leucopus noveboracensis.—Northern White-footed Mouse. This deer mouse and the Canadian deer mouse are the most numerous mice on the reservation. They occur in about equal numbers, and seem to live in identical habitats, although in the deep woods the Canadian deer mouse is the more abundant. Adults and immatures were collected throughout September.

Peromyscus maniculatus gracilis.—Canadian Deer Mouse. This large deer mouse is very common, and several used to come into my cabin every morning and feed on little tidbits I had left on the floor for them. They would feed quietly and without a trace of fear, although I would be sitting within ten feet of them. Occasionally, one would sit up on his hind legs and clean himself with his front paws and tongue, like a kitten or a rabbit. Adults, nursing females, and immatures about half-grown were collected in September. They were found in the low sphagnum bogs along the Wolf River and also in the higher woods, especially in the pines near Neopit.

Clethrionomys gapperi gapperi.—Red-backed Mouse. The red-backed mouse was found to be common in the pine mats and the sphagnum lowlands. They were especially abundant in the sphagnum moss and cedar mats in a cedar swamp about a mile west of Keshena, Wisconsin. They seemed to like the higher parts of the swamp, even though it was damp. None were caught in the higher woods around the swamp. No runways were found, but numerous holes that led to old rotten logs or stumps were seen. Adults, nursing and pregnant females, and immatures were collected in September and early October, 1929.

Microtus pennsylvanicus pennsylvanicus.—Meadow Vole. This is the common mouse of the cleared lands and fields. Adults and immatures were collected in September.

Ondatra zibethica zibethica.—Muskrat. The muskrat is one of the commonest mammals on the reservation, and is found along most of the streams and in the majority of the lakes. Very few houses were seen as they probably live in burrows on the banks of the streams and lakes. The Indian trappers say that the muskrat rarely builds houses anywhere on the reservation. It is probably the most trapped animal, but seems to hold its own against the depredations of the Indian trappers. Several adults and kits were collected on October 7, 1929. The skins were nearly prime, and the Indian trappers were beginning to take them, although they said they were in their best pelage about December and January.

Zapus hudsonius hudsonius.—Hudson Bay Jumping Mouse. This jumping mouse was found nearly everywhere on the reservation, although it seemed to prefer the open pine woods, few being caught in the cut-over lands. One was collected in a sphagnum bog on July 21, 1929. On September 10th of that year,

Chief Oshkosh and his son captured three juveniles about one third grown at Keshena Falls. During the time I was able to keep them they ate a little peanut butter and slept practically all the time. Toward evening, as it grew colder, they seemed to go into a state of semi-hibernation, and could not be awakened, or made to show any sign of life until they were warmed. As soon as they were warmed up, they would move around, but as soon as they were placed in a cool place, they curled up into their characteristic position—that of the adults in hibernation.

Synaptomys cooperi cooperi.—Cooper's Lemming Mouse. Two specimens were collected in the pine mats on a pine ridge just west of Keshena Falls. They were taken in the same location as *Clethrionomys gapperi gapperi*, that is, at holes that led to rotten stumps. One female collected September 12, 1929, measured as follows: Total length, 120 mm.; tail, 19 mm.; hind foot, 19 mm. One male collected September 6, 1929 measured: 105; 17; 18.

Erethizon dorsatum.—Canada Porcupine. The porcupine is very common on the reservation, and is frequently seen along the roads at night. The flesh is esteemed by the Indians, and some are killed for food. The low "chuck-chuck" of these mammals is frequently heard as one walks through the woods after dark, and during the day one occasionally sees them. Three were collected in early October, while many were seen throughout July and September.

Lepus americanus phaeonotus.—Varying Hare. The varying hare is found commonly in the wooded thickets in the northern parts of the reservation, and during winter it is hunted for food by the Indians.

Sylvilagus floridanus mearnsi.—Mearns' Cottontail Rabbit. This is the common rabbit of the reservation, and is found everywhere. It seems to be holding its own, although it is hunted for food during the winter months.

The Chicago Academy of Sciences.

LOCAL DIFFERENCES IN PELAGE CHARACTERS OF PEROMYSCUS

By R. R. Huestis

Following his observation that mice trapped upon a lava bed are appreciably darker than the normal form of the surrounding region, Osgood (1909) goes on to say (p. 16): "Again specimens from the bottom of a dark wooded canyon may be noticeably darker than those from an open hillside only a few hundred yards away." Elsewhere in the text color differences are accounted for in terms of local differences in the environment, although the details of the latter are not specified. To all this may be added the fact that the author's "intergrades" between subspecies typically occupy a territory that is ecologically as well as geographically intermediate and, although Osgood does not specifically do so, one can as properly account for the intergrading type in terms of habitat as in terms of hybridity (Dice, 1931).

I do not think I am unduly influenced by the recollection of my own reaction to Osgood's statement when I say that a good many, perhaps the majority of biologists, do not believe that a correlation of pelage color differences, with very local differences of shade or background in the environment, could be anything more than accidental. Yet if the environment has a selective effect, upon either immigrants or residents, it is the local habitat which will be operative, and, under either circumstance, if animals remain for many generations in a given habitat, which seems probable (Murie, 1931), local groups in different habitats would be expected to differ, as they have been reported to do.

Sumner has made a series of investigations in which he has tested statistically many isolated observations of supposed local color adaptation. For the most part his statistical measurements have corroborated the evidence of field workers. He records, however, some apparently unconforming cases which so directly pertain to the subject that I shall itemize them.

1. *Peromyscus crinitis stephensi* from an island of lava in the Mojave Desert were no darker than specimens taken among the paler rocks elsewhere in the desert. This appears to be a clear cut instance of no local effect upon pelage color.

2. *Peromyscus maniculatus rufinus* from an area of Kaibab limestone outcropping on San Francisco Mountain were hardly any lighter than specimens trapped in a dark-soiled volcanic district at the same altitude, although both races were distinctly darker than a sample of larger mice

(*sonoriensis?*) from Tuba City on the edge of the Painted Desert. In width of tail stripe, however, the limestone series did resemble the narrower-striped Tuba City race rather than their volcanic district neighbors.

3. In the very interesting samples taken in the territory of intergradation between *Peromyscus polionotus polionotus* and *P. p. albifrons*, the mean values for pigmental characters moved statistically toward those of the other race, as the investigator travelled geographically from the territory of *albifrons* toward that of *polionotus*. Unless this can be explained in terms of interbreeding, and we have no actual knowledge of the extent to which races of mice do interbreed under such circumstances, these results would be favorable, as already remarked, to the idea of the effects of local conditions upon pelage color. There was one critical point, however, where relatively large differences were recorded in samples of mice taken only a mile apart. If, as the investigator concluded, the abrupt transition from paler to darker soils in this region is not a causal factor of importance, we have, here, an instance of local color differences without correlative environmental factors to account for them, the reverse of instance 1, above.

In addition to these cases, where samples were measured and statistical constants computed, there are undoubtedly many field observations of the same type of mouse in quite different environments, so the matter must, in the end, be considered in terms of the relative frequency of one condition or another.

In my own experience, based upon the collection and observation of about a thousand adult individuals from various parts of Oregon, a correlation of pelage shade with that of the local environment has been the rule. I have, too, tentatively come to the conclusion that this correlation is due to an environmental effect upon the population and not to the interbreeding of neighboring races; but since circumstances have usually been such as to admit the possibility of the latter interpretation, I have searched for a place where the mentioned correlation of pelage and environmental shade could be found, but where the possibility of its being due to interbreeding was largely ruled out. I found such an area near Roseburg, Oregon. It consisted of two fairly well stocked habitats or associations (Grinnell, 1930) close together geographically but considerably different from one another in vegetative covering. While not identical, the conditions were similar to those mentioned by Osgood as being associated with pelage differences in local groups of mice.

The first habitat (see map) consisted of about 800 yards along a curve of the North Umpqua where slope and southern exposure have brought about a rather open river bank. Back from the river the land is covered in places by a stand of small yellow pines. Elsewhere there are Garry oaks (*Quercus garryana*) and low bushes, never dense enough to impede progress, and often separated by clearings. Here 100 trap nights netted 47 mice,[1] individuals being taken under clumps of wild grape (*Vitis californica*), piles of debris left by high water, and at the base of small bushes. A few Douglas ground squirrels inhabited the cleared portions of the same area, which is really more typical of the Rogue River than of the Umpqua Valley.

The streamside thicket (trapping point No. 2) situated along the South Umpqua and about $3\frac{3}{4}$ miles southwest of trapping point No. 1, was produced by a canopy of deciduous trees at the bases of which was a dense and almost impenetrable growth of evergreen blackberry (*Rubus laciniatus*). Vegetation was as luxuriant here, and shade as intense, as in any similar habitat in the Willamette Valley although, generally speaking, the country around Roseburg is appreciably less wooded than at Eugene. Eighty trap nights netted 80 mice (including 4 *Microtus*), specimens being taken along a river path, and along a secondary road which crosses the river here. Trapping was done on two nights, a month apart, on precisely the same area in each case, and as the traps were set about 60 feet apart, as a maximum, the territory was small and quite homogeneous.

Every precaution was taken to make the measurements of the two series comparable. Adult specimens of both groups were skinned immediately. Immature mice were kept under observation until the incoming adult coat had passed the sampling point on the skin. The "oak and brush" specimens averaged slightly larger—possibly an age difference—while a rather larger proportion of the "thicket" series were killed in winter coat. Neither of these circumstances added to the pigmental differences between them as measured by hair counts. No pigmental differences have been found correlative with differences in sex.

PELAGE DIFFERENCES FOUND IN THE TWO GROUPS

Hair counts and measurements[2] are given in table 1, and histograms of three characters are presented in figure 1.

[1] I could not obtain more mice without going into a different sort of territory.

[2] Counts are made of the different types of hair present on a disc removed from a constant point on the flat skin. The length is the distance from the edge of the disc to the point of the hair sample (Huestis, 1925).

TABLE 1

Hair counts

ASSOCIATION	NUMBER OF MICE	LARGE BANDED HAIRS	BLACK OVERHAIRS	FUR HAIRS	NOT IDENTIFIED	TOTAL NUMBER	AVERAGE NUMBER OF HAIRS
Oak and brush.	36	1,606	1,690	8,811	1	12,108	336
Thicket.....	51	1,882	3,414	15,290	12	20,598	404
		Mean percentages				Average length	
						mm.	
Oak and brush.	36	13.3 ± .43	14.0 ± .40	72.8 ± .49		8.3 ± .05	
Thicket.....	51	9.1 ± .30	16.6 ± .37	74.2 ± .35		8.5 ± .06	
Differences.....		4.2 ± .52	2.6 ± .54	1.4 ± .60		0.2 ± .08	
D/P.E. difference.....		8.1	4.8	2.4		2.5	

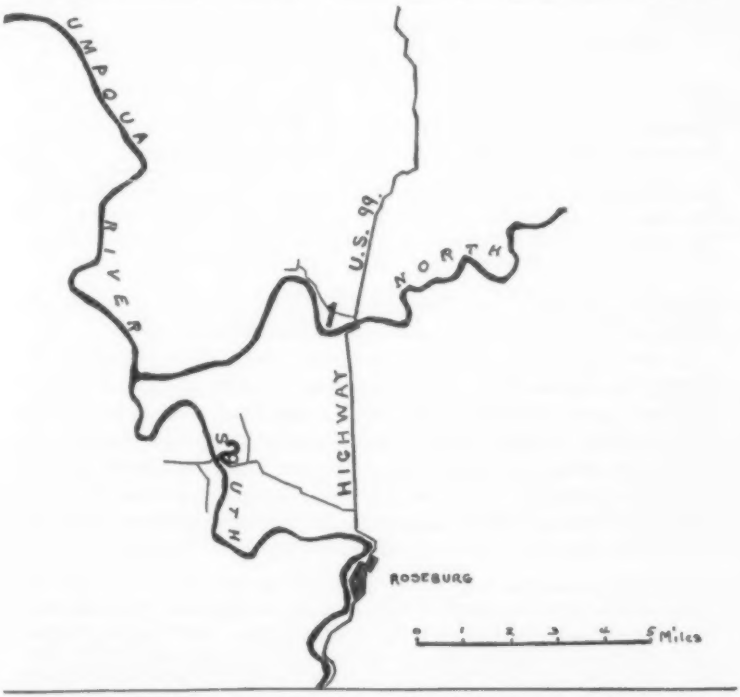

FIG. 1. Map showing junction of branches of the Umpqua River and the secondary roads leading from highway to trapping points at the base of numerals 1 and 2.

It may be observed from the table that the means of the two characters most involved in pelage color difference, the percentage of large banded and of black overhairs, exhibit differences, in the two groups, of fair magnitude, and in spite of the smallness of the samples, of undoubted significance. The percentage of fur hairs, and the length of the hair in the sample do not differ significantly. The small difference in the percentage of fur hairs may be a real one since this percentage varies directly, as a rule, with the percentage of black overhairs. The difference in the number of hairs in the sample is possibly referable to the fact that a greater proportion of the thicket series was skinned in winter coat grown while in the natural habitat.[3] This fact does not vitiate the comparisons of the percentages of different types of hair since it

TABLE 2

ASSOCIATION	LOCALITY	PERCENTAGES			LENGTH OF HAIR
		Large banded hairs	Black overhairs	Fur hairs	
					mm.
Streamside thicket...	Eugene	9.3 ±.40	16.2 ±.31	74.4 ±.49	8.9 ±.06
Streamside thicket...	Roseburg	9.1 ±.30	16.6 ±.37	74.2 ±.35	8.5 ±.06
Oak and brush.....	Roseburg	13.3 ±.43	14.0 ±.40	72.8 ±.49	8.3 ±.05
Pine forest.....	Metolius River	17.7 ±.45	12.2 ±.51	69.7 ±.39	9.3 ±.06

would be expected to operate to reduce slightly and not to increase the differences between the compared percentages (Huestis, 1931).

To give the reader a more comprehensive idea of the characters involved, two comparisons have been made in table 2. The Roseburg "thicket" series is here compared, with a sample of 64 adult mice taken from a similar habitat (most of them trapped in clumps of evergreen blackberry) along the Willamette at Eugene; and the Roseburg "oak and brush" series is compared with 60 pine forest *gambeli* from the Metolius River, east of the Cascades. I am using these latter mice for comparison because I have but six specimens from Southern Oregon,

[3] Since this was written the maturity of 9 more "oak and brush" specimens has increased the number prepared in this series to 45 and made the proportion killed in winter coat the same in both Roseburg groups. So trivial an increase in the percentage of large banded, at the expense of the percentage of fur hairs, and in the average number of hairs per sample, is produced by the addition of these mice, that retabulation and redrawing of figures to include them is not warranted.

the most appropriate comparative area. I might add that although we have areas of Garry oak and brush around Eugene, I have not been able, in several nights trapping, made over a period of years, to take even a small series of mice from them.

I was a little astonished at the similarity of the Eugene and Roseburg samples and hope it does not inspire the reader with distrust. With the exception of hair length, character averages in the paler Roseburg series (oak and brush) are seen to be about midway between those of their thicket-inhabiting neighbors and pine forest *gambeli* from Eastern Oregon. These latter, I might add, are somewhat darker than *gambeli*

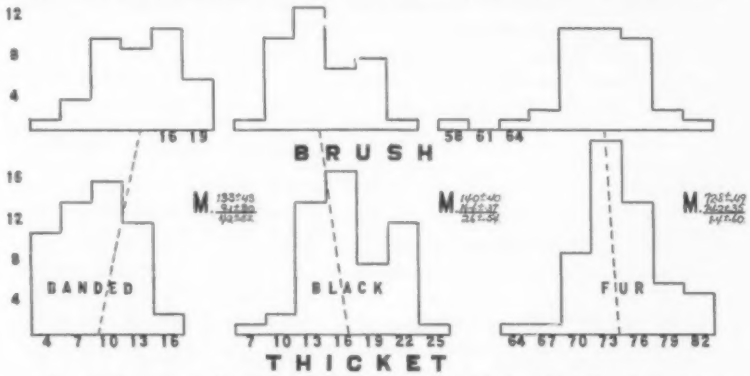

FIG. 2. Frequency distributions for percentages (abcissae) of the three types of hairs in the Roseburg samples. Means of comparable histograms united by dotted line.

taken from a sage brush habitat further east, but not greatly different from the six specimens which I have from Medford in southern Oregon. Length of hair has been found, in previous studies of *Peromyscus eremicus*, to be somewhat correlated with pelage color, paler mice having longer hair. This does not prove to be so in a comparison of the two Roseburg samples, which, in this particular, exhibit close resemblance.

INTERPRETATIONS

Were the geographical positions of the series reversed, the situation could be open to the interpretation that the paler mice were the offspring of immigrants from Southern Oregon while the darker ones were typical of the region or had come from the North or West. The trapping points were selected to obviate this very possibility.

It might be supposed that in as much as the localities from which the samples were taken are separated by a barrier, in this case a river, that alone could account for the difference between them; separated populations having, by chance alone, become different. This cannot be directly disproved. However, it has been shown by Sumner that differences in pigmentation may be present in samples of mice taken only a mile apart and without any physical barrier between them. On the other hand I have, in addition to the Eugene and Roseburg thicket series, with whose similarity the reader is now familiar, three other cases in which similar environments well separated from one another (15–220 miles apart) have yielded samples of mice closely similar in pelage

TABLE 3

GROUP	NUMBER	PERCENTAGES		
		Large banded hairs	Black overhairs	Fur hairs
Unselected	30	22.8 ± .60	9.3 ± .39	67.8 ± .58
Selected "dark"	26	20.2 ± .61	12.5 ± .52	67.3 ± .48
Selected "buff"	25	29.4 ± .73	4.0 ± .27	66.4 ± .72
Differences:				
"Buff" and "dark"		9.2 ± .95	8.5 ± .59	.9 ± .86
Roseburg samples		*4.8 ± .52*	*8.6 ± .54*	*1.4 ± .60*
"Dark" and unselected		2.6 ± .85	3.2 ± .65	.5 ± .75
"Buff" and unselected		6.6 ± .94	5.3 ± .47	1.4 ± .92

characters. While this does not prove that separation alone of two populations will not lead to diversity, in the absence of environmental difference, it has convinced me that it will not do so as a rule.

I think, moreover, that the protective coloration theory of Darwin and Bates, old fashioned as it may be in the opinion of some biologists, meets the exigencies of the present situation better than any other. The theory covers a vast accumulation of naturalistic data and has stood critical investigation, and there is, also, some similarity between the results of a comparison of the differences in the two Roseburg groups with differences obtained in two samples of *Peromyscus* after artificial selection upon a basis of color difference. Professor H. H. Collins, while at Scripps Institution, selected "buff" and "dark" parents in three generations of *P. m. gambeli*, and I am re-presenting, in table 3, percentages obtained from hair counts of a mixed third and fourth genera-

tion lot from each selected group, together with unselected La Jolla *gambeli* also prepared by Professor Collins (Collins, 1923; Huestis, 1925).

Selection for a little over three generations of divergent individuals produced considerably larger differences than those to be noted in a comparison of mice from two different associations, but there is some similarity in the order of magnitude of the differences; they are to be found mainly in the large yellow banded and black overhairs. If a comparison is made between either Collins' selected groups and unselected *gambeli*, however, the differences between the Roseburg series are slightly greater than between "dark" and "unselected" *gambeli* but still appreciably less than those between "buff" and "unselected" *gambeli*. If we may properly use Collins' experiment as a criterion, we can say, then, that the difference between the samples from the two Roseburg associations is a little less in magnitude than the average of that produced by three generations of artificial selection from an unselected sample, on a basis of color difference.

SUMMARY

1. Samples of *Peromyscus* trapped in two different associations, in the Umpqua Valley, were found to differ significantly in two characters which have been shown to be genetic and closely correlated with pelage color.

2. The sample taken in a streamside thicket was found to average darker than the sample taken about four miles north along a relatively open river bank (oak and brush) but to be quite similar, in color, to a sample taken from a streamside thicket seventy miles north.

3. The color difference between the Roseburg samples, as measured by hair counts, was a little less than that produced by about three generations of artificial selection carried on by another investigator.

4. The data add statistical proof to Osgood's statement that there are differences in samples of mice correlative with local differences in the environment, and make it probable that these differences are environmentally produced and not due to interbreeding.

LITERATURE

Collins, H. H. 1923. Journ. Exper. Zool., vol. 38, pp. 45–105.
Dice, Lee R. 1931. Journ. Mammalogy, vol. 12, pp. 210–213.
Grinnell, Joseph, Joseph Dixon and Jean M. Linsdale. 1931. Univ. Calif. Pub. Zool., vol. 35, pp. 1–594.
Huestis, R. R. 1925. Journ. Exper. Zool., vol. 41, pp. 429–470.
——— 1931. Journ. Mammalogy, vol. 12, pp. 372–375.

MURIE, O. J., AND ADOLPH MURIE. 1931. Journ. Mammalogy, vol. 12, pp. 200–209.
OSGOOD, W. H. 1909. North Amer. Fauna, No. 28, pp. 9–285.
SUMNER, F. B. 1921. Journ. Mammalogy, vol. 2, pp. 75–86.
——— 1924. Journ. Mammalogy, vol. 5, pp. 81–113.
——— 1929. Proc. Nat. Acad. Sci., vol. 15, pp. 110–120, 481–493.

University of Oregon, Eugene, Oregon.

A TEST OF SOME RODENT AND BIRD INFLUENCES ON WESTERN YELLOW PINE REPRODUCTION AT FORT VALLEY, FLAGSTAFF, ARIZONA

BY WALTER P. TAYLOR AND D. M. GORSUCH

That certain seed-loving rodents and birds are serious obstacles to successful reforestation by direct seeding under certain circumstances, has been pointed out by Dearborn (1911), Munger (1912), Greeley (1913), Pearson (1913), and a number of other workers (see Taylor, 1927, p. 395–396). In all too few cases, however, has any effort been made to identify the species of animals responsible for the high mortality of seeds and seedlings. The most notable test of this sort with which we are familiar is that of Watt (1923) who in course of his extended investigations of regeneration in British beech woods protected seeded areas with cages designed to exclude different kinds of mammals and birds, and was able to conclude that under the conditions of his work, the wood mouse (*Apodemus sylvaticus*) was the worst mammal enemy of beechnuts and the young seedlings, while among birds the wood pigeon was most serious.

During July, 1925, with the help of G. A. Pearson, Director of the then Southwestern Forest Experiment Station, the writers set up a differential exclosure test in a pasture near the Fort Valley headquarters, Flagstaff, Arizona, in an attempt to identify some of the vertebrates responsible for the disappearance of western yellow pine seeds and seedlings.

An outline of the plots utilized is given in the accompanying diagram (fig. 1). One plot (TUVW) inclosed with fine-meshed hardware cloth, was completely protected from vertebrate intruders, above, on the sides, and even below the surface of the ground. Another plot (MNOD, with seed bed PQRS), was inclosed above and on the sides with one-inch

mesh diagonal wire netting, which, it was anticipated, would exclude everything but mice (*Peromyscus*), and perhaps the young of certain other rodents. Still another plot (EFGH), was fenced on the sides with fine mesh hardware cloth, topped with a ten-inch strip of galvanized iron. The object here was to exclude everything but birds, the plot

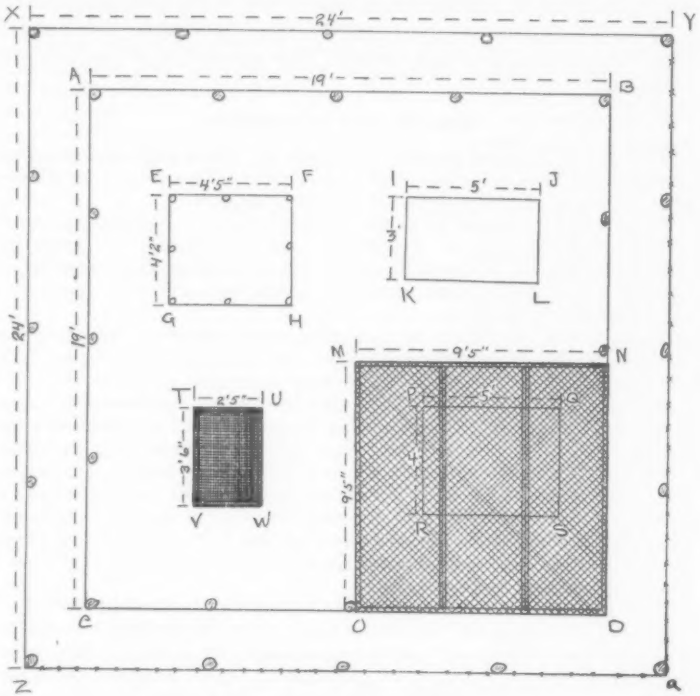

FIG. 1. PLAN OF FENCED PLOTS

Fences of different kinds were relied on to "strain out" the different species of seed-eaters in an attempt to find out the responsible ones.

being open above. Another plot (ABCD, containing seed bed IJKL, and plots EFGH, TUVW, and MNOD), was protected by a two-inch mesh wire netting only. Presumably birds and all kinds of rodents except rabbits had free access to this plot. The plot itself (ABCD), was protected against livestock by a barbed wire fence (XYZa). A

fifth plot was located outside all the fences, and was wide open to the attention of all the interested birds and mammals of the vicinity as well as livestock. Each seed plot, within the protective fences, was approximately 9 square feet in area.

Seeds used in all plots were from a mixed lot from the western yellow pine collected in the bumper seed year of 1919. The planting was done on July 20, 1925, under Pearson's direction, in shallow hills one-half inch deep. The seeds were covered with one-fourth to one-half inch of top soil.

PROGRESS OF THE EXPERIMENT

The first sprouted seed was found on August 10. Three days later a moderate number of seedlings had appeared above the ground. The events in the different plots will now be given as recorded by Gorsuch in the field:

Plot TUVW: By August 17, 10 seedlings had appeared. The number steadily increased until September 25, when 269 seedlings were counted. No damage was recorded in this plot, although rodents made several attempts to dig under the wire. It will be observed (see summary of seedling counts) that this plot showed the highest germination of any.

The favorable germination and persistence of the seedlings in the totally protected plot is probably not the result of protection from vertebrates alone. The fine hardware cloth ($\frac{1}{4}$ inch mesh) undoubtedly exercises a considerable effect, one which has not been analyzed but ought to be taken into account in experiments of this character. The wire reduces insolation, wind movement, evaporation, and transpiration, conserves moisture, and results in more even temperature.

Plot EFGH: The first seedlings were noted on August 17, when 3 were observed. In general there was an increase in number of the seedlings up to a maximum in this plot of 89 on September 23. A few seedlings were lost through damping off.[1] On August 24 the strip of galvanized iron was lowered 8 inches, so as to facilitate the access of birds if any were interested in the seeds or seedlings. No rodent damage was observed in this plot.

Plot IJKL: Eight seedlings appeared on August 13. The seedlings increased to a total of 78 on August 19. Rodent and bird work on the seedlings was observed within two days of the time of their first appearance. On August 15 four holes had been dug for removal of the seeds or seedlings. From this date forward damage was noted every time an observation was made. By August 22 but 12 seedlings remained of the 78 counted in the plot August 19, and by August 24 every seedling had been taken, apparently by the Arizona mantled ground squirrel (*Callospermophilus lateralis arizonensis*). Holes dug after seeds by the squirrels were close together, forming a shallow trench. No more seedlings appeared until September 9, when 7 put in an appearance. This number was not again reached. Four or 5 seedlings persisted up to October 1. At least one seedling had its top gnawed off as if by a mouse. Most of the seedlings disappeared bodily. On September 20 a long-crested jay (*Cyanocitta stelleri diademata*) was noted taking seeds from a baited trap in this plot.

---

[1] Damping off is a disease that attacks first year seedlings in shaded situations.

Plot PQRS: Three seedlings were noted August 13. The numbers increased up to a total of 239. The seeds and seedlings in this plot, protected above and on the sides by inch mesh wire, were unexpectedly free from vertebrate attack. Two cases that looked like either mouse or chipmunk damage were observed. Damping off (see footnote p. 220) took a few seedlings. On October 1, 1925, when the experiment was closed, there were still 226 seedlings in the plot. The snows of winter (1925–1926) broke in the protective top of this plot, which, since that time, has been open above.

Outside: The first seedlings in this unprotected plot appeared on August 15, 2 being noted. Two days later there were 6, and on August 19 there were still 6. By August 21 there were 15 and the next day the maximum number of seedlings, 22, were in evidence. Both rodents and birds appear to have taken part in despoiling this plot. On August 24 not a seedling remained. A scattering 2 or 3 seedlings appeared between September 9 and October 1, but were unable to get started.

SUMMARY OF SEEDLING COUNTS

PLOT	PROTECTED FROM	OPEN TO	MAXIMUM NUMBER OF SEEDLINGS COUNTED				
			1925	1928	1929	1930	1931*
TUVW	All vertebrates	No vertebrates	269	97	99	101	87
PQRS	Birds, squirrels, rabbits, livestock	Mice, chipmunks, perhaps the young of other species	226	14	5	11	10
EFGH	Most or all rodents, livestock	Birds	89	0	1?	2	2
IJKL	Rabbits and livestock	Birds and rodents	78	0	0	0	2?
Outside plot	Nothing	Livestock, birds, rodents	22	0	0	0	0

* The count of 1931 was made by Pearson who also took measurements of the surviving seedlings as follows:

Plot TUVW—(Some seedlings suppressed by competition. A few one or two year seedlings from natural seeding. Height 2 to 14 inches, average 9 inches.)
Plot PQRS—(Height of seedlings, 7 to 13 inches, average 8 inches.)
Plot EFGH—(Height 5 and 8 inches, 1 two years old.)
Plot IJKL—(1 evidently there before fencing.)

BIRDS AND MAMMALS THAT TOOK THE SEEDS AND SEEDLINGS

Among the birds, the long-crested jay and red-shafted flicker (*Colaptes cafer collaris*) were definitely implicated. Six of the former and 2 of the latter were observed feeding in plots IJKL and outside on August 25. The removal of seeds by birds was indicated by small funnel-shaped holes measuring not more than one-half inch in diameter.

The Arizona mantled ground squirrel is the only mammal that was definitely identified as a seed and seedling eater, and even in this case the evidence is somewhat circumstantial. Stumps near the plots had on their surfaces the shells of many pine seeds taken from the plots, together with many *Pentstemon* seed pods; these were mixed with the feces of the mantled ground squirrel. There were mantled ground squirrel burrows under the stumps. Seed shells remaining in the plots were neatly split in half just like those on the stumps. The place of removal of most of the seeds in the plots was marked by small, funnel-shaped holes 1 to 2 inches in diameter at their widest part. In many instances the holes were so close together that they formed shallow trenches. The fact that plot PQRS suffered almost no vertebrate attacks tends further to incriminate the mantled ground squirrel for depredations in plot IJKL.

In a couple of instances, cases of damage apparently the work of a mouse or chipmunk were observed. But these animals, if they were responsible at all for damage the first season, played only a small part in it.

The plots were watched for several hours at a time, but the food takers, with the exception of the birds already mentioned, were not observed.

Subsequent to October 1, 1925, the plots were given no attention, except that counts were made at intervals of a year or longer.

SUMMARY

Western yellow pine seeds were sown in five plots under different degrees of protection from livestock, birds, and native rodents.

Seedlings germinated in all the plots. Few persisted, however, in any plot but the one protected all the way around, including top, bottom and sides.

Species of vertebrates (aside from the horse and cows in the pasture) implicated in the disappearance of the seedlings were: the Arizona mantled ground squirrel (*Callospermophilus lateralis arizonensis*), long-crested jay (*Cyanocitta stelleri diademata*), and red-shafter flicker (*Colaptes cafer collaris*). The junco (*Junco phaeonotus dorsalis*) was not found bothersome in this test (but see Pearson, 1913). The gray-collared chipmunk (*Eutamias cinereicollis cinereicollis*), and white-footed or deer mouse (*Peromyscus maniculatus rufinus*), may also have taken toll of the seedlings.

The method of differential exclosure promises to be useful in helping to determine what "environmental resistance" means as applied to the seeds and seedlings of particular species of trees.

It seems obvious that under natural conditions seed-eating rodents and birds in the long run exercise little or no detrimental effect on the reproduction of western yellow pines or other trees. The forces of nature are balanced in such a way that normally each tree species is adjusted to withstand the pressure of all its enemies. In this experiment we were of course unable to take account of possible insectivorous, soil-working or seed planting activities of rodents and birds. Effective reproduction of western yellow pine in the Southwest depends upon a favorable conjunction of a generous seed crop and favorable rains the following year, a combination which occurs only at intervals. When a favorable season does occur, reproduction takes place in spite of all obstacles. Such studies as the present cover too small a part of the field to help much in outlining a man-

agement plan for rodents. Information in hand is not believed to justify control operations on these species in the yellow pine woods; nor should particular conclusions from isolated investigations be extended too far afield.

LITERATURE CITED

DEARBORN, N. 1911. Seed-eating mammals in relation to reforestation. U. S. Biol. Survey Circ. 78, issued April 4, 1911, pp. 5, figs. in text 3.

GREELEY, W. B. 1913. Reforestation on the national forests. Proc. Soc. Amer. For., vol. 8, pp. 261–277.

MUNGER, T. T. 1912. Natural versus artificial regeneration in the Douglas fir region of the Pacific coast. Proc. Soc. Amer. For., vol. 7, pp. 187–196.

PEARSON, G. A. 1913. Methods of combatting seed-destroying animals. Fort Valley Exper. Sta. Rev. Forest Service Invest., vol. 2, pp. 82–85.

TAYLOR, W. P. 1927. The biological side of the business of forest and forage production. Journ. Forestry, vol. 25, no. 4, pp. 386–414. April.

WATT, A. S. 1923. On the ecology of British beech woods with special reference to their regeneration. Journ. Ecology, vol. 11, no. 1, pp. 1–48, 2 figs.

Tucson Field Office, Biological Survey, U. S. Department of Agriculture, University of Arizona, Tucson, Arizona.

DISTRIBUTION OF THE SOUTH AMERICAN SHREWS

By G. H. H. TATE

My discovery in the literature of "*Blarina pyrrhonota*" Jentinck from Surinam has led me to look into the distribution of the South American members of this family. For convenience, I have grouped these animals in two categories based upon their geography: the Surinam shrews and the Andean shrews (including *merus* Goldman from Eastern Panama).

I. SURINAM SHREWS

The first notice of a shrew living in Surinam is, I believe, that given by Gmelin (1789) under the name *Sorex surinamensis:*

"Sorex with the tail shorter than half body, body above nut-brown, below from ashy white to yellowish. . . . In the ears approaching *araneus*, in size of body, head, snout, teeth, eyes, feet, nearer to *fodiens*. Tail dorsally with densely appressed hairs, ashy above, below whitish; mouth white."[1]

In my opinion the above description can apply only to a shrew. (*S. brasiliensis*, on the other hand, was perhaps *Monodelphis*). The description is too general for specific recognition to be possible.

---

[1] The records of Pennant, Shaw and Schinz are merely transcriptions of the above.

Next, Jentinck (1888) listed "adult mounted individual, type of the species Surinam" under the name *Blarina pyrrhonota*. This remained a *nomen nodum* until he reinstated (1910) the name, this time accompanying it with a good description, unmistakably that of a shrew, and expressing regret that the only geographical data accompanying the animal was "Surinam." Possibly the descriptions of Gmelin and Jentinck are based upon the same specimen.

In view of the apparent restriction in South America of all other shrews to the northern part of the Andes, this locality Surinam must be viewed with doubt. Furthermore, all South American shrews except *pyrrhonota* belong to the genus *Cryptotis*, so that it seems probable that if such an animal really exists in Surinam it must either belong to *Cryptotis* or to some unknown genus,—certainly not to *Blarina*, which does not even enter Central America (See Merriam on *Blarina costaricensis*, North Amer. Fauna, 1895, No. 10, p. 12). Probably Jentinck had before him a shrew wrongly labeled Surinam.

It is with regret, then, that the status of the Surinam shrew must be left in doubt, and I can only urge that some qualified student seize the first opportunity to report upon this specimen, which is presumably at Leyden.

II. ANDEAN SHREWS

Distributional Records.—Since the description of "*Blarina*" *thomasi* Merriam (1897), no less than eight species of shrews have been proposed, ranging through the Andes from Mérida, Venezuela, to Bestion, southern Ecuador. One of them, *Cryptotis medellinus* Thomas (1921) inhabits the northern part of the Central Andes of Colombia, and another, *C. merus* Goldman (1912), is found along the northward extension of the Western Andes in eastern Panama. None has yet been reported from Santa Marta or from Mt. Naguatà, near Caracas. To date two of these forms, *squamipes* J. A. Allen (1912) and *medellinus* Thomas, are known from the type specimens only.

On the sketch map I have plotted all localities known to me either from literature or from American Museum material at which shrews have been taken. It will be noted that most of the material has been received from two origins—namely the Bogotà and Quito regions.

We may perhaps commence our distributional survey with the Quito region. It would seem that unless two distinct groups of shrews are represented here (as at Bogotá), all specimens of *Cryptotis* of this section ought to be referable to *osgoodi* Stone (1914). These would include, apart from the 7 paratypes, a good deal of practically topotypical material from Pichincha: 5 specimens, Lönnberg (1921); 15 specimens, collections of American Museum; and under *equatoris*, Thomas (1912) mentions material from Pichincha. Northwest of Quito: (Gualea, Nono, Mindo), 3 specimens (Lönnberg, l. c.); 1 specimen (American Museum). Inter-andean territory, east of Quito: Mojanda, 2 specimens (Lönnberg, l.c.); Sta. Rosa, R. Pita, San Rafael, Antisanilla, 29 specimens (American Museum). South of Pichincha (near Quito): Corazon, Illiniza, 9 specimens (American Museum). Finally there is Rivet's specimen (Trouessart 1910) from the "Inter-andean plateau."

Next we reach the neighborhood of Chimborazo with Sinche, type locality of *equatoris* (Thomas) (1912). The American Museum possesses 9 topotypes from Sinche, 2 specimens from Carmen west of Sinche, and 1 from Urbina, 12,000 ft., at

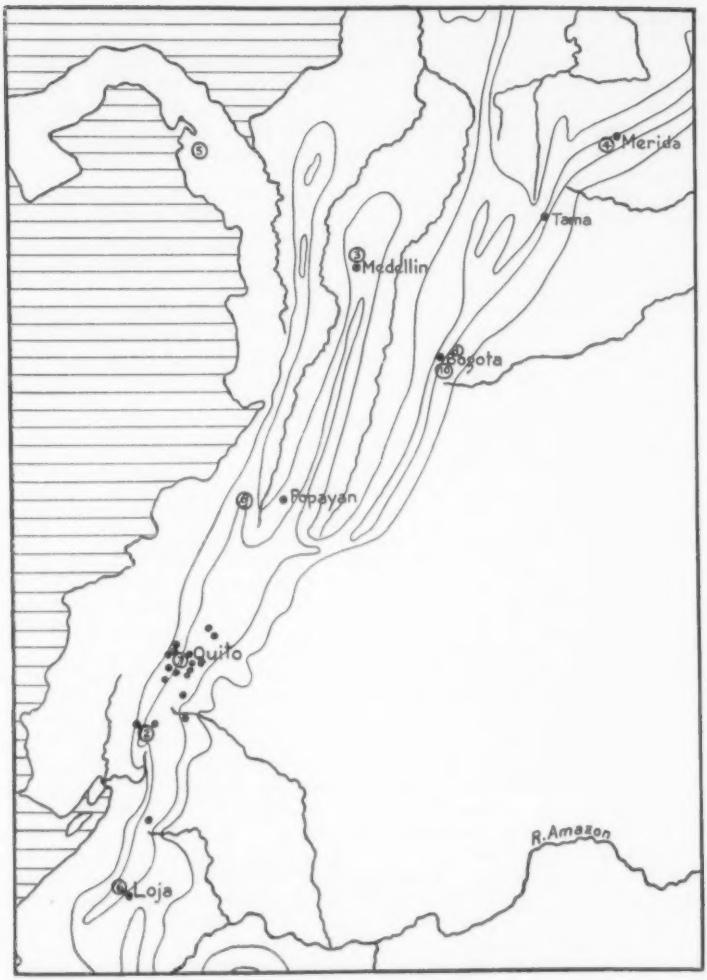

FIG. 1. Type localities (circles) and other places of capture of South American shrews, as follows (*B.* (?) *pyrrhonota* of Surinam could not be shown in cut):

1. *C. thomasi* (Merriam)
2. *C. equatoris* (Thomas)
3. *C. medellinus* (Thomas)
4. *C. meridensis* (Thomas)
5. *C. merus* Goldman
6. *C. montivaga* (Anthony)
7. *C. osgoodi* Stone
8. *B.* (?) *pyrrhonota* (Jentinck)
9. *C. squamipes* (J. A. Allen)
10. *C. avia* G. M. Allen

the eastern foot of Chimborazo. Furthermore from San Francisco on the eastern Cordillera east of Ambato the same Museum has 7 specimens and from San Antonio on the northeast slopes of Tungurahua, 5 specimens. From this generalized and uniform distribution over the whole of the upper part of the Andes of Northern Ecuador, it seems that *osgoodi* and *equatoris* may be conspecific. *Cryptotis montivaga* (Anthony) (1921) from Bestion is based on 5 specimens. Finally, from Chical, between Huigra and Cañar, the American Museum has 9 shrews, which may be referable to this species.

Turning now to the Bogotá region, two distinct groups, according to G. M. Allen (1923) are found: *avia*, representing the *mexicana* group, and *thomasi*. *Cryptotis avia*, which was described from a single specimen from El Verjón, is not unique, the American Museum possessing two individuals, both of them from the type locality and apparently collected at the same time as the type.

Cryptotis thomasi (Merriam) is recorded from all about Bogotá: Páramo de Bogotá, 2 (Amer. Mus.); R. San Francisco, 2 (Amer. Mus.); Páramo de Coachi, 1 (Amer. Mus.). I have little doubt that a number of additional specimens from this same area could be reported from the museums of London, Berlin, and Chicago.

From the Venezuelan Andes we have records of *meridensis* described by Thomas from Mérida: four specimens, which must be nearly topotypical, collected this spring by the Ottley-Anthony Expedition of the American Museum, and the record by Osgood (1912) from the Páramo de Tama. *C. squamipes* and *medellinus* remain isolated records. *C. merus* Goldman (1912, 1920) from 4500 feet seems to belong in a distributional class by itself. To help determine its status collections are needed from all along the northern part of the western Andes.

Habitat.—In Ecuador, the habitats generally occupied by *Cryptotis* are small (often tiny) brush-filled "quebradas" or gullies in the "paramo" and upper forest zone. Shrews share the runways of *Caenolestes fuliginosus*, *Thomasomys baeops* and *Oligoryzomys*. Such places give not only shelter but ample food, since they furnish refuge from the winds of the open paramo for many sorts of insects. Similar habitats occur all over the inter-andean plateau from 10,000 to 14,000 feet. In the adjoining forests, whose trees are gnarled and moss-covered, the shrews are prone to occupy the bases of trees, tunnelling their runways through the damp bryophytes. In the upper subtropical or lower temperate forest (Carmen and San Antonio) their runways are formed beneath logs and tree stumps in the wet forest, their behavior in these localities not differing materially from that of our northern shrews. In all probability the habitats of the *Cryptotis* of the high mountains of Colombia and Venezuela will be found to agree essentially with those of Ecuadorean shrews. In the case of *C. merus* however, Goldman (1920, p. 39) describes the habitat as "the slopes and crests of the mountains above 3,000 to 8,500 feet altitude . . . . densely forested, but . . . . smaller growth than in much of the Lower Tropical Zone. . . . . The northeast trade winds cause precipitation or cloud formation, affecting the northern slopes . . . . during the so-called "dry" season. Fogs and generally moist conditions . . . . reach 500 feet down the northern slope. . . . "

It will be noted that the upper tropical zone of Goldman largely equals the subtropical zone of Chapman and others.

EXTENT AND LIMITS OF DISTRIBUTION. TIME OF ARRIVAL IN THE ANDES

Trouessart (1910), reporting Rivet's findings, implies the inter-andean distribution of *Cryptotis*, but Lönnberg (l.c. p. 4) in his division of the fauna into western and eastern groups denies this by implication, listing *"Blarina"* as a western species. My own experience (in Ecuador) has been that shrews are widely dispersed not only all over the plateau but also on the outer Andean slopes, down which they may range as low as 7600 feet (Carmen, 7600 feet, west of Sinche, and San Antonio, 7600 feet, east of Tungurahua). It must be recalled that the inter-andean plateau with its bordering ranges of volcanoes virtually disappears as Colombia is entered, the system breaking up into the three great Cordilleras, Western, Central and Eastern Andes, separated from one another by the deep valleys of the Cauca and Magdalena Rivers. The shrews (excepting *C. merus*) seem able to occupy only the upper parts of these ranges, one of which extends to Mérida, Venezuela. Granted that suitable habitats exist, shrews will probably be found throughout the Andes of Ecuador, Colombia, and Venezuela from about 7500 feet up to the limit of brushy vegetation. The fact that none has been observed in Peru and southwards, although *montivaga* is common in the highlands of southern Ecuador, suggests that some kind of "barrier" is functioning. The Huancabamba pass, which seems to stop so many temperate plants and animals, is naturally to be regarded as constituting that barrier. I suspect, though, that were this saddle not also the seat of considerable aridity, the shrews might have passed it. In the same way no shrews appear to have traversed the relatively low ranges from the mountains of Colombia and Mérida to Santa Marta and to Naguatá in Venezuela (9,000 ft.).

Without much evidence beyond its rather limited distribution, I am inclined to think that *Cryptotis* may have entered South America during the Pleistocene glacial periods, when, presumably, temperatures at Panama may have been slightly lower and the biosphere was undergoing great readjustments. There is no evidence to show that any large physiographical changes have taken place since that time, so we may suppose that the route followed was southward along the range between the Atrato River and the Pacific, *merus* being left behind in Mt. Pirri, and then up onto the Andes. According to Antevs (1928, p. 155) this took place not less than 29,000 years ago, so, if we accept this estimate, the present small Andean radiation in *Cryptotis*, which may have begun very much earlier, has been in process for at least that length of time.

LITERATURE

ALLEN, G. M. A new shrew from Colombia. Proc. New England Zool. Club, 1923, vol. 8, pp. 37–38. (*Cryptotis avia*, n. sp.)

ALLEN, J. A. Mammals from Western Colombia. Bull. Amer. Mus. Nat. Hist., 1912, vol. 31, p. 93. (*Blarina* (*Cryptotis*) *squamipes*, n. sp.)

——— List of mammals collected in Colombia by the American Museum of Natural History expeditions, 1910–1915. Bull. Amer. Mus. Nat. Hist., 1916, vol. 35, p. 224. (*Cryptotis thomasi* (Merriam).)

ANTEVS, E. The last glaciation. Amer. Geogr. Research Series, No. 17, 1928.

ANTHONY, H. E. Preliminary report on Ecuadorean Mammals, No. 1. Amer. Mus. Novit. No. 20, 1921, p. 5. (*Blarina montivaga*, n. sp.)

GMELIN, J. F. Linnaeus Syst. Nat., 1789, vol. 1, p. 114. (*Sorex surinamensis.*)

GOLDMAN, E. A. New mammals from Eastern Panama, (R. Limon, Mt. Pirri, E. Panama), Smiths. Misc. Coll., 1912, vol. 60, No. 2, p. 17. (*Cryptotis merus*, n. sp.)

——— Mammals of Panama. Smiths. Misc. Coll., 1920, vol. 69, No. 5, p. 171. (*Cryptotis merus* Goldman.)

JENTINCK, F. A. Catalogue Systematique des Mammifères. Muséum d'Histoire Naturelle des Pays-Bas, 1888, vol. 11, p. 131. (*B. pyrrhonota* Jentinck, *nomen nudum.*)

——— Description of a new shrew from Surinam. Notes Leyden Museum, 1910, vol. 32, p. 167. (*Blarina pyrrhonota* Jentinck.)

LÖNNBERG, E. A second contribution to the mammalogy of Ecuador. Ark. Zool. Stockholm, 1921, vol. 14, no. 4, pp. 4, 67. (*Blarina equatoris* Thomas.)

MERRIAM, C. H. Description of five new shrews from Mexico, Guatemala and Colombia. Proc. Biol. Soc. Wash., 1897, vol. 11, p. 227. (*Blarina thomasi*, n. sp.)

OSGOOD, W. H. Mammals from Venezuela and eastern Colombia. Field Mus. Nat. Hist. Publ. 214, Zool. Ser. 1912, vol. 10, no. 5, p. 62. (*Blarina meridensis* Thomas.)

STONE, W. On a collection of mammals from Ecuador. Proc. Acad. Nat. Sci. Phila., 1914, vol. 66, p. 16. (*Blarina osgoodi*, n. sp.)

THOMAS, O. On seven new small mammals from Ecuador and Venezuela. Ann. Mag. Nat. Hist., 1898 (7) vol. 1, pp. 451–457. (*Blarina meridensis*, n. sp.)

——— Three small mammals from South America. Ann. Mag. Nat. Hist., 1912 (9), vol. 9, pp. 408–410. (*Blarina equatoris*, n. sp.)

——— New *Cryptotis*, *Thomasomys* and *Oryzomys* from Colombia. Ann. Mag. Nat. Hist., 1921, (9) vol. 8, pp. 354–357. (*Cryptotis medellinus*, n. sp.)

TROUESSART, E. L. Mammifères de la Mission de l'Equateur, d'après les collections formées par le Dr. Rivet—in Mission de l'Equateur, 1910, vol. 9, Pt. 1, p. 6. (*Blarina* (*Cryptotis*) *thomasi* Merriam.)

The American Museum of Natural History, New York, N. Y.

RECORDS AND DISTRIBUTION OF THE FOSSIL BEAVER, CASTOROIDES OHIOENSIS

By Alvin R. Cahn

With the discovery of the excellent skull of *Castoroides ohioensis* Foster in McLean County, Illinois, in 1929, the writer began a study of this interesting species. The first contribution he offered in the August, 1930, issue of this journal; this paper constitutes the second of the series.

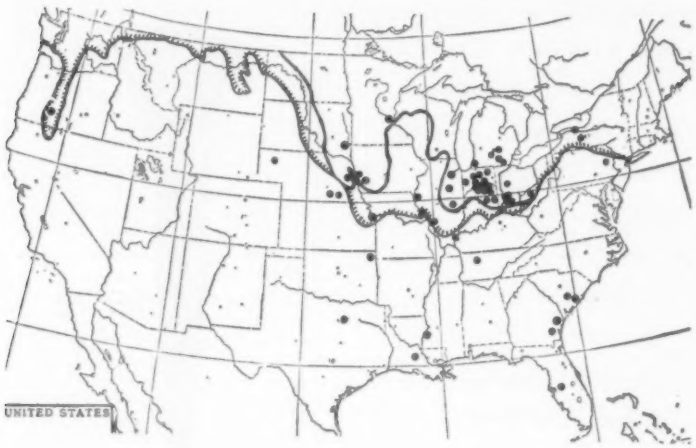

Fig. 1. Showing the location of fossils of *Castoroides ohioensis* in relation to the extent of the ice sheet. Hatched line: southern limit of glaciation. Solid line: Wisconsin Drift.

A future paper will deal with the cranio-osteology and myology of the form.

The literature dealing with the fossil beaver in North America—and *C. ohioensis* is strictly a North American animal so far as we now know—is plentiful but very scattered, occurring in both biological and geological publications throughout the country. An effort has been made to bring all this together in the hope that those who are interested in this giant rodent may be saved much search of the literature, some of which is not always available. In gathering this information and attempting to locate the present whereabouts of the material, an appeal was published

in Science, and a reprint of this was mailed to 283 museums, colleges, and universities. The responses were not what might have been expected, but many interesting data were obtained, some material long lost sight of was located, and several new records were brought to light. To those institutions and individuals who responded so graciously the writer expresses his thanks. Many specimens still remain unaccounted for, however.

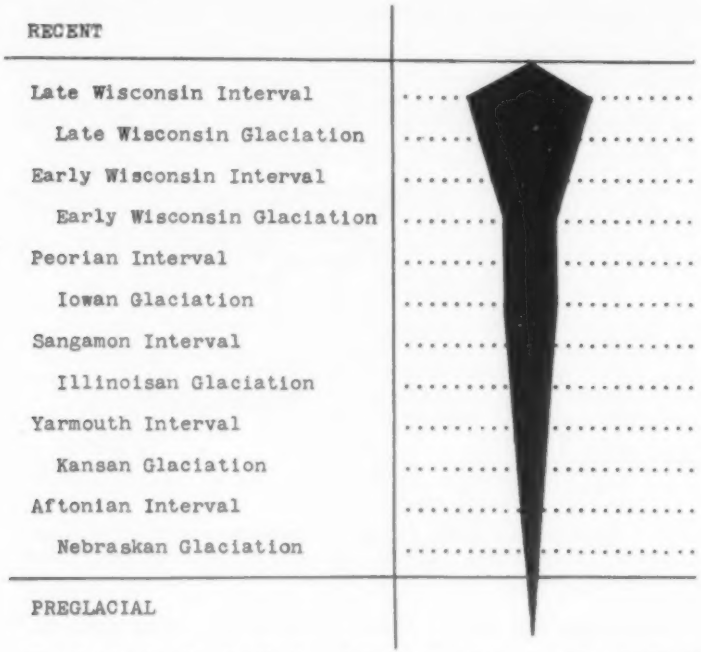

FIG. 2. Showing the distribution of *Castoroides ohioensis* during the Glacial Period, as indicated by fossils found within the glaciated area.

Under the following state headings are listed all the recorded and known finds of *C. ohioensis*, with a brief statement of what the material consists, its present location, its position within the Pleistocene as nearly as can be determined, and a list of authors who have mentioned the particular specimen in publication. The exact references will be found by consulting the bibliography. In the case of specimens found

outside of the glaciated region, it is either impossible or extremely difficult to place them in their proper period in Pleistocene time, and the value of an approximation which may actually be far from the truth is doubtful; hence it has not been attempted.

RECORDS OF CASTOROIDES ARRANGED ACCORDING TO STATES

NEW YORK

1. Clyde specimen, Wayne County. Skull and right ramus of the lower jaw; now in New York State Museum, Albany.
   Age: After the close of the Wisconsin glaciation.
   References: Wyman, 1846 (figure); Hall, 1846; Hall and Wyman, 1847 (description of skull); Leidy, 1869; Baker, 1920; Hartnagel and Bishop, 1922; Hay, 1923; Abel, 1929 (figure).
2. Lenox specimen, Madison County. Lower left incisor, from Cowaselon creek; now in New York State Museum, Albany.
   Age: After the close of the Wisconsin glaciation.
   References: Smith, 1914; Hartnagel and Bishop, 1922; Hay, 1923.

PENNSYLVANIA

1. Stroudsburg specimen, Monroe County. Both rami of the lower jaw, with three temporary molars and three permanent molars, from Hartman's Cave; present location of material unknown.
   Age: Probably late Wisconsin.
   References: Leidy, 1880; Leidy, 1887 (figure); Mercer, 1894; Rhoads, 1894; Hay, 1923.

OHIO

1. Nashport specimen, Muskingum County. Two right rami of lower jaw, one upper incisor, four molars and a radius. This is the type material; present location of material unknown.
   Age: Sangamon Interval.
   References: Hildreth, 1837 (first mention; not named); Foster, 1837 (original description; figure); Whittlesey, 1848; Agassiz, 1851; Leidy, 1869; Baker, 1920; Hay, 1923.
2. Wilmington specimen, Clinton County. Prof. W. C. Mills informed Dr. Hay of the find of "a fine skull, without the lower jaw" on the west border of Wilmington; location of material unknown.
   Age: Late Wisconsin.
   Reference: Hay, 1923.
3. Germantown specimen, Montgomery County. One incisor, from Twin Creek; location of material unknown.
   Age: Probably early Wisconsin.
   References: Orton, 1870; Newberry, 1870; Hay, 1923.
4. West Sonora specimen, Preble County. Fragment of upper incisor; now in Earlham College; no. 5546.
   Age: Wisconsin (Englewood moraine).
   References: Moore, 1890; Moore, 1893; Baker, 1920; Hay, 1923.

5. Greenville Library specimen, Darke County. Fragment of upper incisor, from Bridge creek, 1889; specimen now in public library at Greenville.
   Age: Wisconsin (Sidney moraine).
   References: Baker, 1920; Hay, 1923.
6. Greenville specimen, Darke County. Fragment of left upper incisor; now in Earlham College; no. 5539.
   References: Langdon, 1883; Moore, 1893; Moore, 1899 (figure and measurements); Hay, 1923.
7. New Knoxville specimen, Auglaize County. Good skull; now in Heidelburg University, Tiffin, Ohio.
   Age: Wisconsin.
   References: Williamson, 1905 (figure); Williamson, 1912; Hay, 1923.
   This skull is said to have been found inside the beaver's house. This house is described as being 3–4 feet high and 8 feet square, made of cuttings 3 inches in diameter.

INDIANA

1. Vanderburgh specimen, Union County. Nothing is known of this material—neither of what it consisted nor exactly where it was found, other than the county.
   Age: Yarmouth interval.
   References: Collett, 1876; Hay, 1912; Baker, 1920; Hay, 1923.
2. Richmond specimen, Wayne County. Fragment of upper incisor, from two miles east of Richmond; location of material unknown.
   Age: Post Wisconsin.
   References: Moore, 1890; Moore, 1893; Hay, 1912; Hay, 1923.
3. Greenfield specimen, Hancock County. Part of skull, lacking premaxilla; now in Earlham College; no. 5534.
   Age: Post Wisconsin.
   References: Moore, 1899 (figure); Hay, 1912; Hay, 1923.
4. Jamestown specimen, Boone County. Lower jaw, with base of both incisors and full set of molars; now in collection of the Geological Survey of Indiana at the State Museum, Indianapolis.
   Age: Late Wisconsin.
   References: Hay, 1912; Hay, 1923.
5. Summitville specimen, Madison County. Premaxilla with right incisor; now in the State Museum, Indianapolis.
   Age: Wisconsin.
   References: Hay, 1912; Hay, 1923.
6. Winchester specimen, Randolph County. A nearly complete skeleton, the only one known; now mounted in Earlham College; no. 5537. Also in Earlham College, from Randolph County: no. 5540, right humerus; no. 5542, fragment of incisor; no. 5543, right lower incisor; no. 5544, bone fragments; no. 5547, head of rib; no. 5548, upper end right radius; no. 5549, upper end right ulna; no. 5550, upper end third metatarsal right; no. 5552, heel bone; no. 5554, bone fragment, no. 5555, four bone fragments.
   Age: Post Wisconsin.

References: Moore, 1890; Moore, 1893 (figure complete); Hay, 1912; Hay, 1923.

7. Fairmount specimen, Grant County. About three fourths of a skeleton, with skull and lower jaw; now in the Field Museum, Chicago; no. P12118.
   Age: Wisconsin.
   References: Hay, 1912; Hay, 1923.
8. Carroll specimen, Carroll County. Nothing is known of the details of this find other than the county record.
   Age: Wisconsin.
   References: Collett, 1884; Cope and Wortman, 1884; Baker, 1920; Hay, 1923.
9. Logansport specimen, Cass County. A good skull, lacking lower jaw; found in 1894; now in the U. S. National Museum; no. 1634.
   Age: Wisconsin.
   References: Hay, 1912 (figure); Hay, 1923.
10. Macy specimen, Miami County. Lower right incisor, from Allen Township; location of material unknown.
    Age: Wisconsin.
    Reference: Hay, 1923.
11. Kosciusko specimen, Kosciusko County. "Bones and teeth." Nothing further is known of this discovery.
    References: Collett, 1884; Cope and Wortman, 1884; Hay, 1912; Baker, 1920; Hay, 1923.
12. Grovertown specimen, Stark County. Good skull and left half of the mandible; now in the Field Museum, Chicago; no. P12290.
    Age: post glacial; from within the limits of Lake Kankakee.
    Reference: Hay, 1923.
13. DeKalb specimen, DeKalb County. Upper incisors in premaxilla; now in U. S. National Museum; no. 11335.
    Age: Wisconsin.
    Not mentioned in literature.
14. Mt. Ayr specimen, Newton County. A single mandible; now in Field Museum, Chicago, no. P14728.
    Age: Wisconsin.
    Not mentioned in literature.

ILLINOIS

1. Shawneetown specimen, Gallatin County. Two molars, upper incisor, two petrous bones; now in the Academy of Natural Sciences, Philadelphia.
   Age: Probably late Wisconsin.
   References: LeConte, 1852; Leidy, 1869; Hay, 1923; Baker, 1930.
2. Alton specimen, Madison County. Fragments of teeth; upper incisor, left incisor, enamel plate of molar. From loess deposit. Collected by McAdams in 1883; now in U. S. National Museum; nos. 9035, 9036, 9037.
   Age: Probably Sangamon.
   References: Worthen, 1890; Baker, 1920; Hay, 1923; Baker, 1930.

3. Charleston specimen, Coles County. A good skull, lacking both zygomatic arches and incisors; location of material unknown.
   Age: Early Wisconsin.
   References: Leidy, 1867; Leidy, 1869; Baker, 1920; Hay, 1923; Baker 1930.
4. Naperville specimen, DuPage County. Skull and "other parts of skeleton;" destroyed by burning of Wood's Museum in Chicago, 1871.
   Age: Post Wisconsin.
   References: Bannister, 1870; Hay, 1923, Baker, 1930.
5. Quincy specimen, Adams County. "Remains found in loess;" nothing further is known of this material.
   Age: Sangamon interval.
   References: Worthen, 1870; Baker, 1920; Baker, 1930.
6. Bellflower specimen, McLean County. A fine skull, lacking zygomatic arches and left incisor; now in Natural History Museum, University of Illinois.
   Age: Early Wisconsin.
   References: Baker, 1930; Cahn, 1931.
7. St. Joseph specimen, Champaign County. Fragments of incisor; material found near St. Joseph, but could not be purchased from the finder.
   Age: Early Wisconsin (?).
   Not mentioned in literature.

TENNESSEE

1. Memphis specimen, Shelby County. Large portion of right half of lower jaw, with 4 molars; now in Academy of Natural Sciences, Philadelphia.
   Age: Location not accurate enough to determine.
   References: Wyman, 1850 (figure); Leidy, 1869; Hay, 1923.

SOUTH CAROLINA

1. Charleston specimen, Charleston County. Parts of two incisors. From Cohen collection from phosphate beds; now in American Museum of Nat. Hist.; no. 13716. Not mentioned in literature.
2. Charleston Scanlon specimens, Charleston County. Fragments of five teeth; now in Yale University Museum.
   Reference: Hay, 1923.
3. Charleston Pinckney specimen, Charleston County. One fourth premolar.
   Reference: Hay, 1923.
4. Ashley specimen, Charleston County. "Fragments of teeth;"? now in American Museum of Nat. Hist.; no. 480.
   References: Leidy, 1860 (figure); Leidy, 1869.

GEORGIA

1. Brunswick specimen, Glynn County. Fragment of incisor; now property of Geological Survey of Georgia, Atlanta.
   References: Gidley, 1911, Hay, 1923.
2. Savannah specimen, Chatham County. Portion of upper incisors, from Savannah River; now in U. S. National Museum; no. 11720.
   Not mentioned in literature.

FLORIDA

1. Sarasota specimen, Sarasota County. Several imperfect teeth; now in private collection of J. E. Moore, Sarasota.
   Age: From Melbourne beds of the Pleistocene.
   Reference: Simpson, 1929.

LOUISIANA

1. Louisiana specimens, locality unknown. "Remains." Nothing is known of these specimens.
   References: Hall and Wyman, 1847; Wyman, 1850; Leidy, 1869.

MISSISSIPPI

1. Natchez specimen, Adams County. "Remains." Nothing is known of this find.
   References: Hall, 1846; Hall and Wyman, 1847; Leidy, 1869; Hay, 1923.

TEXAS

1. Dallas specimen, Dallas County. Portions of several lower incisors and parts of molars; from alluvial deposits on the Trinity River.
   References: Coues and Allen, 1877; Moore, 1893.

OKLAHOMA

1. Afton specimen, Ottawa County. Fragments of incisor; now in U. S. National Museum; no. 9126.
   Not mentioned in literature.

KANSAS

1. Biocourt specimen, Linn County. A fine skull, with most of under parts complete; all molars present, but no incisors; zygomatic arches and occipital region missing; now in Kansas University Museum; no. 3196.
   Reference: Martin, 1912.
   This skull is described as a new species, *Castoroides kansensis*, but as will be shown in a later paper, the present writer, after examining the specimen, believes it to be identical with *C. ohioensis*.

NEBRASKA

1. Hay Springs specimens, Sheridan County. "Remains;" two molars, no. 2781; two astragali, nos. 2696, 2718; humerus, no. 2719; cervical vertebra and atlas, no. 2720; ulna; now in American Museum of Nat. Hist.
   Age: Pre-glacial.
   References: Matthew, 1902; Hay, 1914; Hay, 1915; Baker, 1920; Osborn, 1910.
2. Florence specimen, Douglas County. Small fragment of incisor; now in U. S. National Museum; no. 9273.
   Not mentioned in literature.
3. Spring Ranch specimen, Clay County. Fine complete incisor; found in 1925 in gravel pit, 17 miles southeast of Hastings; now in Hastings Museum; no. 90655.
   Not mentioned in literature.

4. Dorchester specimen, Saline County. Lower jaw, with both incisors in place; found in sand pit in 1928; now in Hastings Museum; no. 98723.
   Not mentioned in literature.

South Dakota

1. Sioux Falls specimen, Minnehaha County. Upper molar. Found in Collins pit; location of material unknown.
   References: Calvin, 1911; Hay, 1912; Shimek, 1912.
2. Sioux Falls Hayes specimen, Minnehaha County. About two inches of upper incisor; found in Hayes pit, 2 miles northeast of Sioux Falls, in 1927, in Kansan glacial gravel; now in University of South Dakota Museum, Vermillion.
   Not mentioned in literature.

Iowa

1. Oakland Specimen, Pottawattamie County. Incisor tooth; from Nishnaboina River; now in Iowa State University Museum; no. 106.
   Age: Aftonian interval.
   References: Calvin, 1911; Hay, 1914; Baker, 1920.
2. Turin specimen, Monona County. Fragment of incisor from Elliott pit; now in Iowa State University Museum; no. 279.
   References: Calvin, 1911; Hay, 1914.

Michigan

1. Berrien specimen, Berrien County. A very fine skull and associated lower jaw, lacking the left ramus; now in American Museum of Nat. Hist.; no. 10383.
   Age: Post-Wisconsin.
   References: Hay, 1914 (figure); Hay, 1923.
2. Adrian specimen, Lenawee County. Good skull, lacking the lower jaw; now in U. S. National Museum; no. 197.
   Age: Post-Wisconsin.
   References: Martin, 1912 (figure); Baker, 1920; Hay, 1923.
3. Pittsfield specimen, Washtenaw County. Slightly injured skull, lacking lower jaw; lacks left zygoma, all molars except last on left side; only right incisor present; found in 1902; now in Museum of Geology, University of Michigan; no. 3110.
   Age: Late Wisconsin.
   References: Wood, 1914; Baker, 1920.
4. Attica specimen, Lapeer County. Fragment of upper incisor; now in Alma College, Alma, Michigan.
   Age: Late or Post-Wisconsin.
   References: Baker, 1920; Hay, 1923.
5. Owosso specimen, Shiawassee County. Greater portion of right mandible, with incisor and all molars in position; base of left ramus and left incisor; found in 1892; now in Museum of Geology, University of Michigan; no. 3109.
   References: Wood, 1914; Baker, 1920; Hay, 1923.

6. Lenawee specimen, Lenawee County. Skull now in U. S. National Museum; no. 1634.
References: Martin, 1912; Baker, 1920.

MINNESOTA

1. Minneapolis specimen, Hennepin County. Left ramus of mandible; location of specimen unknown.
References: Winchell, 1879; Baker, 1920.

OREGON

1. Christmas Lake specimen. "Remains." Nothing is known of this find, other than the general location.
References: Matthew, 1902; Hay, 1914; Osborn, 1910, Simpson, 1930.

ALASKA

1. Yukon specimen. Yukon Territory. Part of a femur; found near the Arctic Ocean. Now in U. S. National Museum.
Reference: Hay, 1912.

In the foregoing list there is but one item concerning which I have grave doubts. The New Knoxville specimen from Auglaize county, Ohio, is reported by Williamson (1905) to have been found inside of its house. This "house" is reported as being between 3 and 4 feet high and 8 feet square, and made of 3 inch wood. Now, since the skull associated with this "house" is that of a good sized animal, we are confronted with the problem of putting a beaver nearly 6 feet long and 2 feet high into a square house measuring 8 feet by 4 at the most. Undoubtedly these measurements of the house are *outside* measurements, for it would be very difficult to measure the inside (room) cavity of a collapsed house; hence the inside measurements would of necessity be considerably less than the figures given. There is something wrong here.

CASTOROIDES IN PLEISTOCENE TIME

A survey of the foregoing records shows in so far as the glaciated region of North America is concerned, the distribution of *Castoroides* during the Pleistocene. A single record is pre-glacial; Aftonian, 1; Yarmouth, 1; Sangamon, 3; Early Wisconsin, 4; Late Wisconsin, 6; Wisconsin (but not definitely placed within the period), 9; Post-Wisconsin, 8; Of recent, or Pliocene, records there are none.

The giant beaver seems, from fossil evidence, to have been most abundant in the region of Indiana, and most of the specimens are referable to the Wisconsin glaciations. In this and other regions it lived through the last of the inter-glacial intervals, and then quite suddenly became extinct. Like many of the other mammalian forms that lived contemporaneously, it reached abundance and then suddenly disappeared. What might have been the cause of this extinction is not clear, for we know of no especially violent or startling change from the Wisconsin intervals to the recent existing conditions—neither topographic, hydrographic, climatic, nor biotic. Still, it would not require a radical change to have a profound effect upon a highly specialized form. There is no evidence that man was

associated with its disappearance. There does not seem to have been any associated mammalian form, such as a large carnivore, that might have preyed upon it to such an extent as to exterminate it. Can the animal itself explain its own extinction?

This beaver was a *giant* rodent, with specialized characteristics even more highly emphasized than those of the modern beaver (*Castor canadensis*). The mounted skeleton in Earlham College measures 5 feet, 4 inches as it stands, and has a maximum height of 20¾ inches. The skull is about 12 inches in length, the incisors 6 inches long. Such an animal must have weighed about 500 pounds. The modern beaver weighs about 50 pounds, has a skull length of about 5 inches, armed with incisors an inch long. Its body is bulky and heavy; its legs are short. *Castor* is clumsy on land, and has great difficulty in going over the rough terrain that marks the glaciated country in which it lives because of those very physical characters that make it such a successful aquatic animal. How much more difficulty then, must *Castoroides*, with these characteristics still more emphasized, have had in leaving the water? Then why leave it? A modern beaver colony of let us say 10 individuals will cut down from 50 to 75 trees a year in order to live, and the bulk of the food is limited to two species of trees. Those trees are cut which, when felled, will be available to the animal from the water; hence the time must eventually come, as it actually does, when the beaver must leave the water in order to obtain food. The animals *must* then go inland for trees, or migrate, and this migration may well be an overland journey of great difficulty. Imagine, then, a colony of 10 *Castoroides*, weighing 500 pounds instead of 50 pounds each. If *Castor* cuts 50 trees a year, how many hundred would the *Castoroides* have to cut in the same time in order to subsist? And if the *Castor* colony in, relatively, a few years runs out of water-edge food trees, and is then forced upon land excursions for food, how much quicker would the *Castoroides* be forced into the same predicament. Then would come the time of forced land marches, which the bulk and structure of the great beaver would render almost prohibitive. I doubt if they could have done it successfully. Some slight change, then, in the physiography of the country, plus the high specialization of the animal, would easily explain its extermination.

BIBLIOGRAPHY

ABEL, O. Palaeobiologie und Stammesgeschichte, Jena, 1929.

AGASSIZ, L. Report on vertebrate fossils. Proc. Amer. Assoc. Adv. Sci., vol. 5, pp. 178. 1851.

BAIRD, S. F. Mammals of North America, p. 362. 1857.

BAKER, F. C. The life of the Pleistocene. Bull. Univ. of Illinois, vol. 17, p. 41. 1920.

BAKER, F. C. A new record of Castoroides ohioensis from Illinois. Science (n.s.), vol. 71, no. 1841, p. 389. 1930.

BANNISTER, H. M. Geology of DeKalb, Kane and DuPage Counties. Geol. Illinois, vol. 4, p. 113. 1870.

CAHN, A. R. Information concerning Castoroides. Science (n.s.), vol. 70, no. 1826, p. 635. 1929.

CAHN, A. R. A study of the auditory ossicles of the living and fossil beaver. Journ. Mamm., vol. 11, no. 3, p. 392. 1930.

CALVIN, S. Aftonian mammalian fauna. Bull. Geol. Soc. Amer., vol. 22, pp. 207–216. 1911.

COLLETT, J. Vanderburgh County. Geol. Surv. Ind., 7th Ann. Rept., p. 245. 1876.

COLLETT, J. Post-Pliocene vertebrates. 14th Ann. Rept. Geol. Surv. Indiana, pt. 2, p. 37. 1884.

COPE, E. D. Review of the Rodentia of the Miocene period of North America. Bull. U. S. Geol. Geog. Surv. Terr., vol. 6, no. 2, p. 361. 1881.

COPE, E. D. The extinct rodentia of North America. Amer. Nat., vol. 17, no. 1, pp. 370–379. 1883.

COPE, E. D. and J. L. WORTMAN. Post-Pliocene vertebrates of Indiana. 14th Ann. Rept. Geol. Nat. Res. Indiana, p. 37. 1884.

COPE, E. D. The mechanical causes of the origin of the dentition of the Rodentia. Amer. Nat., vol. 22, no. 3, p. 11. 1888.

COUES, E. and J. A. ALLEN. Monograph of American Rodentia. U. S. Geol. Surv., vol. 11, pp. 423–426. 1877.

DEKAY, J. E. Natural history of New York. Zool. New York., vol. 1, p. 89. 1842.

FOSTER, J. W. Cincinnati Quart. Journ. Sci., vol. 31, p. 80. 1837.

FOSTER, J. W. Description of Castoroides ohioensis. 2nd Rept. Geol. Ohio, pp. 80–83. 1838.

GIDLEY, J. W. Bull. 26, Geol. Surv. Georgia, p. 436. 1911.

HALL, J. On the geological relations of the fossil Castoroides ohioensis. Proc. Boston Soc. Nat. Hist., vol. 2, p. 167. 1846.

HALL, J. and J. WYMAN. Notice on the geological position of the cranium of the Castoroides ohioensis. Boston Journ. Nat. Hist., vol. 5, art. 39, pp. 385–401. 1847.

HARTNAGEL, C. A. and S. C. BISHOP. The mastodons, mammoths and other Pleistocene mammals of New York State. Bull. New York State Mus., nos. 241–242. 1922.

HAY, O. P. The Pleistocene period and its vertebrates. Indiana Dept. Geol. Nat. Res., 36th Ann. Rept., pp. 539–784. 1912.

HAY, O. P. The recognition of Pleistocene faunas. Smith. Misc. Coll., vol. 59, no. 20, p. 13. 1912.

HAY, O. P. The Pleistocene mammals of Iowa. Iowa Geol. Surv., vol. 13, pp. 1–662. 1914.

HAY, O. P. Contributions to the knowledge of the mammals of the Pleistocene of North America. Proc. U. S. Nat. Mus., vol. 48, pp. 515–575. 1915.

HAY, O. P. The Pleistocene of North America. Carnegie Inst. Publ. 322, 1923.

HAY, O. P. The Pleistocene of the Middle Region of North America. Carnegie Inst. Publ. 322A, 1924.

HILDRETH, S. R. Cabinet of the Atheneum at Zanesville. Amer. Journ. Sci., vol. 31, p. 79. 1837.

LANGDON, F. W. Journ. Cincinnati Soc. Nat. Hist., vol. 6, pp. 238–239. 1883.

LECONTE, J. Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 53. 1852.

LEIDY, J. [On a skull of Castoroides]. Proc. Acad. Nat. Sci. Philadelphia, p. 97. 1867.

LEIDY, J. Synopsis of extinct mammals of North America. Journ. Acad. Nat. Sci. Philadelphia, 2nd ser., vol. 7, p. 405. 1869.

LEIDY, J. Bone caves of Pennsylvania. Proc. Acad. Nat. Sci. Philadelphia, p. 347. 1880.

LEIDY, J. Ann. Rept. Geol. Surv. Pennsylvania, p. 14. 1887.

MARTIN, H. T. On a comparison of three skulls: Castoroides ohioensis, C. kansensis and Castor. Kansas Univ. Sci. Bull., vol. 6, no. 6, p. 389. 1912.

MATTHEW, W. D. List of Pleistocene fauna from Hay Springs, Nebraska. Bull. Amer. Mus. Nat. Hist., vol. 16, p. 317. 1902.

MATTHEW, W. D. and J. W. GIDLEY. Mammals of the Miocene of South Dakota. Bull. Amer. Mus. Nat. Hist., vol. 20, p. 257. 1904.

MERCER, H. C. Reëxploration of Hartman's Cave. Proc. Acad. Nat. Sci. Philadelphia, p. 98. 1894.

MILLER, G. S., JR., and J. W. GIDLEY. Synopsis of the supergeneric groups of rodents. Journ. Wash. Acad. Sci., vol. 8, no. 13, p. 431. 1918.

MOORE, J. A recent find of Castoroides. Amer. Nat., vol. 24, p. 767. 1890.

MOORE, J. Concerning a skeleton of the great fossil beaver. Journ. Cincinnati Soc. Nat. Hist., vol. 13, p. 138. 1890.

MOORE, J. Concerning some portions of Castoroides not heretofore known. Proc. Amer. Assoc. Adv. Sci., vol. 39, p. 265. 1890.

MOORE, J. The recently found Castoroides in Randolph County, Indiana. Amer. Geol., vol. 12, p. 68. 1893.

MOORE, J. A cranium of Castoroides found at Greenfield, Indiana. Proc. Indiana Acad. Sci., pp. 171–173. 1899.

NEWBERRY, J. S. Proc. Lyc. Nat. Hist. New York, vol. 1, p. 83. 1870.

NEWBERRY, J. S. [Remarks.] Proc. Lyc. Nat. Hist. New York., vol. 2, no. 4, p. 92. 1874.

ORTON, E. Amer. Journ. Sci., ser. 2, vol. 50, p. 54. 1870.

OSBORN, H. F. The age of mammals, 1910.

PALMER, T. S. Index Generum Mammalium. North Amer. Fauna 23, p. 843. 1904.

RHOADS, S. N. A contribution to the life history of the Allegheny cave rat. Proc. Acad. Nat. Sci. Philadelphia, p. 218. 1894.

SCOTT, W. B. The evolution of the premolar teeth in the Mammalia. Proc. Acad. Nat. Sci. Philadelphia, p. 410. 1892.

SCHREUDER, A. Conodontes (Trogonotherium) and Castor from the Tehlian Clay. Archiv. d. Mus. Teyler, ser. 3, vol. 6, pp. 99–318. 1929.

SCHREUDER, A. Conodontes, Trogonotherium and other Castoridae. Palae. Zeitschr., vol. 13, pp. 148–176. 1931.

SHIMEK, B. Pleistocene of Sioux Falls, South Dakota, and vicinity. Bull. Geol. Soc. Amer., vol. 23, p. 143. 1912.

SIMPSON, G. G. Hunting extinct animals in Florida. Nat. Hist., vol. 29, no. 5, p. 506. 1929.

SIMPSON, G. G. Rodent giants. Nat. Hist., vol. 30, no. 3, p. 305. 1930.

SMITH, P. A new locality for Castoroides. Amer. Journ. Sci., vol. 38, no. 40, p. 463. 1914.

WEBER, M. Die Säugetiere, p. 512. 1904.

WHITTLESEY, J. Notes on the drift and alluvium of Ohio and the west. Amer. Journ. Sci. Arts, vol. 2, no. 5, p. 215. 1848.
WILLIAMSON, C. W. History of Ohio and Auglaize County, p. 338. 1905.
WILLIAMSON, C. W. [Reprint of preceding.] Geol. Surv. Ohio., Bull. 16, p. 39. 1912.
WINCHELL, N. H. Notes on some Post-Tertiary phenomena in Michigan. Amer. Nat., vol. 4, p. 504. 1870.
WINCHELL, N. H. Castoroides ohioensis, Foster. 8th Ann. Rept. Minn. Geol. Nat. Hist. Surv., pp. 181–183. 1879.
WOOD, N. A. Science (n.s.), vol. 39, no. 1012, p. 759. 1914.
WORTHEN, A. H. Adams County. Geol. Illinois, vol. 4, p. 46. 1870.
WORTHEN, A. H. Drift deposits of Illinois. Geol. Illinois, vol. 8, p. 8. 1890.
WYMAN, J. [On Castoroides ohioensis.] Proc. Boston Soc. Nat. Hist., vol. 2, p. 138. 1845.
WYMAN, J. Notice of fossil bones from the neighborhood of Memphis, Tennessee. Amer. Journ. Sci. Arts, ser. 2, vol. 10, p. 62. 1850.
WYMAN, J. Proc. Boston Soc. Nat. Hist., vol. 3, p. 281. 1850.

Zoological Laboratory, University of Illinois, Champaign, Ill.

THE PANNICULUS CARNOSUS AND POUCH MUSCULATURE OF THE OPOSSUM, A MARSUPIAL

BY ORTHELLO R. LANGWORTHY

The development of reflex activity in pouch-young opossums was studied in this laboratory; in these investigations adult animals were used for controls (Weed and Langworthy, 1925 and Langworthy, 1925). This work provided an abundance of material, physiological, morphological and in a sense embryological, for the study of the superficial trunk musculature in this interesting species in which a portion of the muscle in females has been differentiated to form a well developed pouch.

The author in previous communications has considered the morphology of the panniculus carnosus in two carnivores—cat and dog (1924); and in a rabbit, and three rodents—rat, porcupine and guinea-pig (1925). The panniculus carnosus is derived from the pectoral musculature as evidenced by its innervation through the anterior thoracic nerve and by the insertion of certain portions of the muscle into the humerus along with the pectoral muscles. Present only in mammals, this superficial muscle has become enormously developed in certain species, spreading widely over the thorax, abdomen, back and proximal portion of the hind-limb. It lies just beneath the skin in the superficial fascia and pannicu-

lus adiposus and on contraction causes wrinkling of the skin. Huber (1922–23) has clearly shown that the facial musculature and panniculus carnosus are entirely separate and distinct as evidenced by their nerve supply although, in the region of the neck, they often lie close together, overlap or even secondarily fuse; the facial musculature is innervated by the facial nerve, the panniculus carnosus by the N. thoracalis anterior.

Ruge (1905, 1910 and 1914) and Tobler (1902) have presented convincing proof that certain muscle-rests occasionally found in man, the achselbogen and sternalis muscles, are derived from the panniculus carnosus of lower mammals. Tobler (1902) has, in fact, traced the regression of the superficial trunk muscle in Primates from a well developed muscle to primitive rests much like the achselbogen. The achselbogen is sometimes closely fused with the latissimus dorsi, and this has led former workers to a false conception of its derivation (Le Double, 1897).

Portions of the panniculus carnosus are often differentiated from the main muscle mass to subserve particular uses; thus many variations in form and extent are found. Ruge (1895) early showed that, in *Ornithorhynchus*, fibers encircle the mammary glands while in *Echidna* a portion of the muscle has been differentiated to form a cloacal sphincter. The author has demonstrated that in the cat a few of the more caudal fibers have become sharply separated from the main muscle mass, looping down over the lower abdomen to insert upon the prepuce in the male and beneath the sphincter of the vagina in the female. Physiological stimulation of the anterior thoracic nerve confirmed the morphological observation that a small branch of the nerve could be traced to these muscle fibers. In the male dog a more strongly developed preputial muscle is found; similar fibers in the female end upon the fascia of the upper abdomen. Among the rodents, the rat possesses a well developed preputial muscle while the fibers in the female end in the abdominal fascia. In the rabbit and guinea-pig no tendency to form such a preputial muscle is seen. The ventral portion of the muscle in the guinea-pig may be divided into two distinct layers, of which the superficial is inserted into the fascia on the outer side of the humerus. The panniculus carnosus in this animal has no connection with the greater tuberosity of the humerus nor with the pectoral musculature; it is innervated nevertheless by the N. thoracalis anterior, showing clearly its phylogenetic origin.

The panniculus carnosus is strongly developed in the porcupine, possibly because of its functional importance in helping to move the quills. Here groups of fibers have become separated from the main

muscle mass to form a preputial muscle, a superficial thigh muscle and an achselbogen similar to that found in man. These examples illustrate the great variability of the muscle; it is concerning an analogous differentiation of the panniculus carnosus in the marsupial to form the pouch musculature that this paper particularly deals.

A recent paper by Zeiger (1925) is of interest, considering as it does the possible function of the "Hautrumpfmuskeln" in examples of the Xenarthra. In *Bradypus tridactylus*, the three-toed sloth, the panniculus carnosus consists of two distinct portions, both innervated by the anterior thoracic nerve. One portion, called by Zeiger "pectoralis quartus," arises from the seventh to tenth ribs and is inserted upon the humerus with the pectoralis minor. The fibers of the other portion arise from the seventh and eighth ribs and sweep over the lateral surface of the body wall and lateral surface of the thigh to insert into the fascia around the patella. Zeiger interprets variations of the panniculus carnosus in Xenarthra in terms of physiological adaptations. The three-toed sloth hangs almost constantly by the fore-legs from the limbs of trees with the body ventro-flexed and coiled. The pectoralis quartus in this position assists the pectoralis minor in supporting the body weight when the arms are extended and externally rotated. The other portion of the panniculus carnosus may aid in flexing and rotating the thigh but he postulates that its chief function is the support of the abdominal wall in the static position at the place of greatest strain. In the sloth suspended from a tree the back lies below and the ventral surface above so that the greatest strain upon the abdominal wall is laterally.

The ant-eater *Tamandua tetradactyla* has the panniculus carnosus well developed over the anterior surface of the abdomen. Here again Zeiger believes its function is the support of the pendent abdomen and in this group of animals he minimizes the importance of its connection with the skin. If Zeiger's theory be correct, it would apply in a similar way to the carnivores and rodents. It scarcely seems possible that so thin a sheet of muscle could offer any adequate support to the viscera.

The designation "pectoralis quartus" of Zeiger should by no means be confused with the term "fourth pectoral" used by the author to describe a group of fibers belonging to the pectoral musculature of carnivores and rodents and arising from the third to fifth ribs. It extends upward and laterally to insert into the lower border of the first rib, and is innervated by a branch of the first thoracic nerve. When, as in *Tamandua*, the portion of the panniculus carnosus inserting upon the humerus

is more closely correlated with the other fibers of the muscle, Zeiger calls it not "pectoralis quartus" but the "pars humeralis" of the "Hautrumpfmuskel". In the papers of the present author dealing with carnivores and rodents it has been found convenient to consider the panniculus carnosus as composed of two portions. The fibers of the muscle inserting upon the humerus with the pectoral musculature called by Zeiger "pectoralis quartus" or "pars humeralis of the Hautrumpfmuskeln"

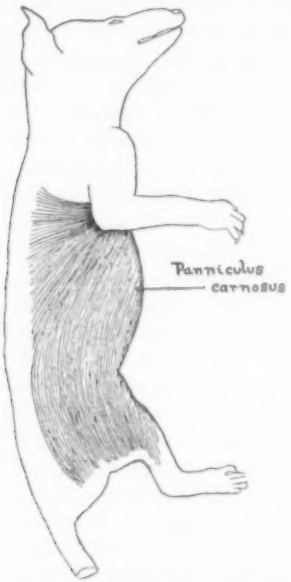

FIG. 1. Lateral view of panniculus carnosus of the opossum

have been designated as the cranial portion, while the fibers having both their origin and insertion in superficial fascia have been spoken of as the caudal portion.

PREVIOUS STUDIES OF THE PANNICULUS CARNOSUS OF MARSUPIALS

Kohlbrugge (1898) described the panniculus carnosus in a number of marsupials and showed that only a portion of the muscle was inserted upon the humerus with the pectoral musculature. The portion arising and inserting in superficial fascia he believed was innervated by the lateral rami of the intercostal nerves.

Tobler (1902) gave an account, with careful drawings, of the panniculus carnosus in *Macropus bennetti*. The muscle in the kangaroo consists also of a free portion with fibers originating and inserting in fascia and a main muscle mass inserting upon the humerus. The free portion covers the upper thorax and lower back. It arises from the fascia over the lower border of the pectoral musculature and from the ventral midline for some distance below; the fibers extend obliquely and posteriorly to end in the fascia at the level of the thigh. The main muscle extends dorsalward, meeting the fibers from the opposite side in the dorsal midline. The most caudal fibers of the two sides come to lie almost parallel and end at the base of the tail. In the axilla, the broad spreading muscle becomes very narrow; it slides under the edge of the pectoralis and is attached with the abdominal portion of the pectoralis to the humerus and coraco-brachialis fascia. The anterior thoracic nerve innervates the muscle. Tobler pictured the panniculus carnosus of the male and did not examine the pouch musculature.

Since the panniculus carnosus is derived from the pectoral musculature, it seems important to describe the arrangement of the pectoral musculature in the animals studied. This has already been done in the case of the carnivores and rodents and lagomorphs previously reported and the same method of description will be followed here.

MORPHOLOGY OF THE PECTORAL MUSCULATURE AND PANNICULUS CARNOSUS OF THE ADULT OPOSSUM

The pectoralis superficialis of the opossum (Figs. 2 and 4) is a broad layer of muscle arising from the fascia covering the sternum from its upper border as low as the middle of the sixth interspace, the fibers converging to an insertion in the anti-brachial fascia and ridge of the greater tuberosity of the humerus. This muscle in different specimens is more or less clearly divided into two portions. The cranial and more superficial portion is shaped like an equilateral triangle, its fibers ending in the upper two-thirds of the common insertion, while the fibers of the more caudally inserting portion run upward and beneath the superficial fibers to end along the whole length of the terminal tendon. The pectoralis superficialis is innervated by the seventh and eighth cervical nerves through the brachial plexus (Fig. 3).

The pectoralis profundus (Figs. 2 and 3) is a rectangular muscle arising from fascia covering the sternum from the fourth rib to the xiphoid process and inserting into the upper portion of the ridge and greater tuberosity of the humerus. It too may be divided into a well differentiated cranial and caudal portion.

The pectoralis abdominalis (Figs. 2, 3 and 4) can be identified in this animal as a separate and distinct muscle, originating from the xiphoid process and the linea alba of the upper third of the abdomen and passing behind the pectoralis profundus to insert into the greater tuberosity and coracoid process of the humerus. The pectoralis profundus and pectoralis abdominalis are innervated by the eighth cervical and first thoracic nerves.

A fourth pectoral layer (Fig. 3) arises from the sternum by an aponeurosis extending from the second to the fourth ribs and runs upward and lateralward to insert into the lower border of first rib. It is innervated by a filament from the first thoracic nerve.

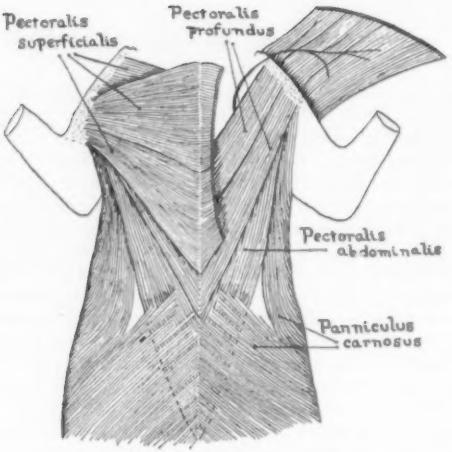

FIG. 2. Pectoral musculature of the opossum (pectoralis superficialis, pectoralis profundus and pectoralis abdominalis) and panniculus carnosus in relation to it. On left side pectoralis superficialis cut and reflected to show innervation.

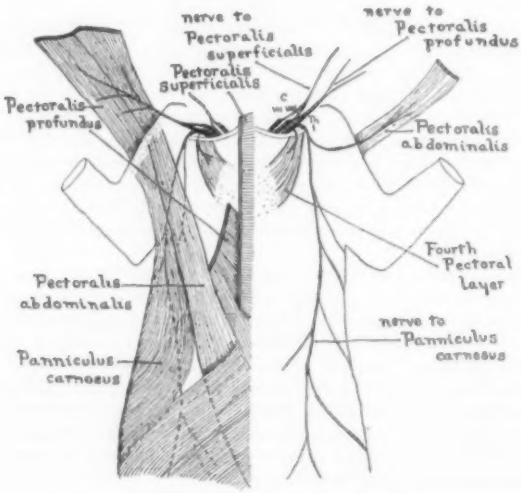

FIG. 3. Fourth pectoral layer, panniculus carnosus and nerve supply to the whole pectoral group and panniculus carnosus in the opossum. On right side, pectoralis superficialis cut and only origin indicated. Pectoralis profundus indicated cut and reflected to show innervation. On left side, fourth pectoral group and the N. thoracalis ant. for innervation of panniculus carnosus.

The panniculus carnosus (Figs. 1, 3 and 4) is well developed in the opossum. If Tobler's figures be consulted it will be found that the muscle has practically the same differentiation here that it has in the kangaroo. The superficial trunk musculature in the opossum may be divided into a cranial and caudal portion (Fig. 4). The caudal fibers (Fig. 4) cover the lower trunk, upper abdomen and lower back. Arising in distinct bundles from the fascia over the lower border of the pectoralis profundus and from the linea alba in the upper half of the abdomen, they spread out to form a homogeneous, thin layer of muscle that sweeps laterally and posteriorly to end in the fascia of the back and dorsal surface of the thigh (Fig. 1). A few of the more caudal fibers (Fig. 4) loop sharply downward and

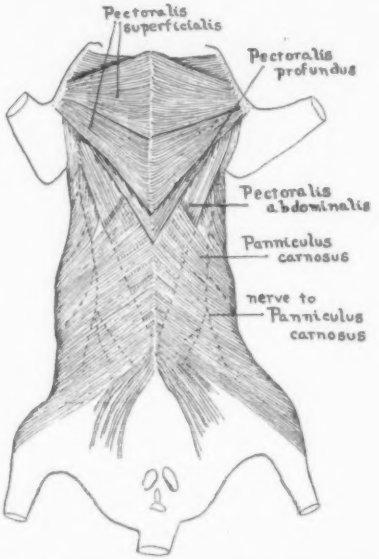

FIG. 4. Ventral view of panniculus carnosus and pectoral musculature in the male opossum. Innervation of panniculus carnosus indicated.

curve toward the midline to end finally in the fascia of the lower abdomen. These fibers do not meet or fuse across the midline at their insertion but are connected by a fascial ridge forming in the female the lower wall of the pouch. The pouch musculature then is of very simple arrangement but admirably suited to support the young. The caudally directed loops of fibers are analogous to those which form the preputial muscle in the male cat and dog and end around the vaginal orifice in the female cat. They show much the same form and extent seen in the female dog. In the male and female opossum they show a similar arrangement although they are much more strongly developed in the female and surround the

breasts. They become enormously hypertrophied when young are carried in the pouch.

The cranial portion of the muscle (Figs. 1 and 4) arises from the fascia covering the back some little distance from the dorsal midline. The fibers converge to form a thick band that passes across the axilla to insert into the ridge of the greater tuberosity of the humerus just below the pectoralis abdominalis (Fig. 3). A few of the more caudal fibers insert into the tendon of the pectoralis abdominalis (Fig. 2). The panniculus carnosus of the opossum is innervated by the eighth cervical and first thoracic nerves through the N. thoracalis anterior.

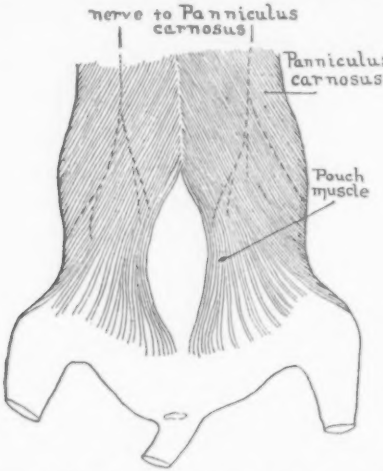

FIG. 5. The formation of the pouch musculature from the panniculus carnosus in the female opossum. The pouch musculature is innervated by a branch of the N. thoracalis ant.

PHYSIOLOGICAL STUDY OF THE INNERVATION OF THE PANNICULUS CARNOSUS OF THE OPOSSUM

Huber and Hughson (1922–23) confirmed the common opinion concerning the innervation of the facial musculature of the cat and dog by methods of nerve stimulation. The animals were decerebrated and the cerebellum removed so that the facial nerve was exposed; later separate branches were isolated.

The lateral branches of the intercostal nerves pierce the panniculus carnosus and from time to time it has been claimed that they participated in its innervation. Kohlbrugge believed that this was true for the marsupial. Accordingly, in adult opossums, the anterior thoracic nerve was exposed and stimulated. Contraction of the entire panniculus carnosus and pouch musculature occurred. Conversely, stimulation of the intercostal nerves caused no contraction of this muscle. The innervation of the panniculus carnosus is proved in this way beyond

all doubt. In female opossums that had suckled young in the pouch to the age of maturity the pouch musculature was enormously relaxed. But even in these animals stimulation of the anterior thoracic nerve caused such a strong contraction that the edges of the pouch met in the midline.

EMBRYOLOGICAL DEVELOPMENT OF THE POUCH MUSCULATURE

The opossum is born at the end of a twelve day gestation period when approximately 11 mm. in length. The fore legs are well differentiated; the hind legs are merely extensive buds. Formerly it was believed that the young opossums were placed in the pouch by the mother; but Hartman (1921), has shown that the young climb into the pouch by grasping the hair of the mother with the claws of the forefeet. Once inside they become firmly attached to the nipple, and activity for several weeks is definitely limited. In our experiments opossums were removed from the pouch from time to time for observation and study.

Eight animals, 10 days of age, measuring 22 mm., crown to rump, and 27 mm., nose to rump, were studied in the laboratory. They had the bodily characteristics of fetal animals with fairly well developed forelegs and poorly developed hindlegs. No coat of fur had yet appeared; the skin was pink, greatly wrinkled and almost transparent, exposing clearly to view the sutures of the skull, the liver, and other abdominal organs. A round opening served for a mouth, traumatized by freeing from the nipple, and no mouth groove had yet appeared. A ring of pigment in the iris indicated the position of the developing eye. The pinnae of the ears had not separated from the underlying skin. The forelegs were muscular and the toes had well developed claws, the hindlegs were one-third their size and poorly differentiated.

In these young opossums no pouch could yet be made out, and as no scrotal sac had yet differentiated in the male, it was impossible to determine sex by superficial examination. Stimulation with a unipolar electrode in the thoracic region caused local stimulation of muscle fibers belonging to the panniculus carnosus, but no contraction of superficial fibers in the region later occupied by the pouch was obtained. Morphological studies upon such small animals are difficult but we are convinced that the panniculus carnosus is, at this time, in early stages of development.

Another opossum when studied was 14 days of age, 27 mm. in crown to rump and 40 mm. in nose to rump measurement. The pinnae had separated from the underlying skin, and the mouth groove was visible. This animal showed a distinctly formed pouch. In males of about this same age the scrotal sac first appears. At some time between the tenth and fourteenth day of extra-uterine life the panniculus carnosus becomes sufficiently developed so that the pouch may be clearly demonstrated. The muscle continues to grow and differentiate along with the other bodily structures and the pouch definitely deepens. Soon the mammae become visible inside the confines of the pouch.

SUMMARY

The panniculus carnosus is well developed in the opossum and consists of a portion attached to the humerus with the pectoral musculature and a portion having both origin and insertion in superficial fascia. As in other mammals the panniculus carnosus is innervated by the anterior thoracic nerve; this has been

proved not only morphologically but also by physiological experiment. The superficial trunk musculature of this animal is of particular interest since ventral fibers have become differentiated in the female to form the pouch musculature. The opossum is born when extremely immature and the panniculus carnosus is not completely differentiated at birth. About the fourteenth day of extra-uterine life the pouch musculature can be demonstrated.

LITERATURE CITED

HARTMAN, CARL. 1921. Breeding habits, development and birth of the opossum. Smithsonian report, Publ. 2689, p. 347.

HUBER, ERNST. 1922–23. Über das Muskelgebiet des Nervus fascialis beim Hund. Morphol. Jahrb., vol. 52, pts. 1–2, no. 4, p. 353.

——— 1924. Über die Bedeutung der experimentellen Methode in der Facialisforschung, nebst Betrachtungen über die phylogenetische Entwicklung der Facialismuskulatur in der Vertebratenreihe. Anat. Anz., vol. 58, p. 177.

KOHLBRUGGE, J. H. F. 1898. Die Homotypie des Halses und Rumpfes eine vergleichende untersuchung der Hals- und Brustnerven und ihrer Muskeln, mit einem Anhang über den N. Facialis. Archiv. f. Anat. u. Entwicklungsgeschichte, Leipzig, p. 199.

LANGWORTHY, O. R. 1924. The Panniculus carnosus in cat and dog and its genetical relationship to the pectoral musculature. Journ. Mammalogy, vol. 5, p. 49.

——— 1925. A Morphological study of the Panniculus carnosus and its genetical relationship to the pectoral musculature in rodents. Amer. Journ. Anat., vol. 35, p. 283.

——— 1925. The development of progression and posture in young opossums. Amer. Journ. Physiol., vol. 74, p. 1.

LEDOUBLE. 1897. Traité des Variations du Système musculaire de l'homme et de leur signification au point du vue de l'anthropologie zoologique. vol. 1, 177, Paris.

RUGE, GEORG. 1895. Die Hautmuskulatur der Monotremen und ihre Beziehungen zu dem Marsupial- und Mammar-apparate. [Semon's zoologische Forschungsreisen.] Jenaische Denkschriften, vol. 5, pp. 77–153, pls. 12–14.

——— 1905. Zusammenhang des M. sternalis mit der Pars abdominalus des M. pectoralis major und mittelst dieser mit den Achselbogen. Morphol. Jahrb., vol. 33, p. 348.

——— 1905. Der Hautrumpfmuskel der Säugetiere, der M. sternalis und der Achselbogen des Menschen. Morphol. Jahrb., vol. 33, p. 379.

——— 1910. Ein Rest des Hautrumpfmuskels in der Achselgegend des Menschen; Achselbogen. Morphol. Jahrb., vol. 41, no. 4, p. 519.

——— 1910. Neue Mitteilungen uber die Sternalis Frage. Morphol. Jahrb., vol. 41, no. 1, p. 337.

——— 1914. Der Hautrumpfmuskel des Menschen. Morphol. Jahrb., vol. 48, no. 1, p. 1.

TOBLER, LUDWIG. 1902. Der Achselbogen des Menschen. Morphol. Jahrb., no. 3.

WEED, L. H., AND O. R. LANGWORTHY. 1925. Decerebrate rigidity in the opossum. Amer. Journ. Physiol., vol. 72, p. 25.

ZEIGER, KARL. 1925. Beiträge zur Kenntnis der Hautmuskulatur der Säugetiere. Die Hautrumpfmuskeln der Xenarthra. Morph. Jahrbuch, vol. 54, no. 2, p. 205.

Department of Anatomy, Johns Hopkins University, Baltimore, Md.

STATUS OF INTERNATIONAL CONVENTION FOR PROTECTION OF WHALES

BY LEWIS RADCLIFFE

The prosecution of the whale fishery has been greatly intensified during the past quarter of a century, and extended to all seas where whales abound. The perfection of floating factory ships with displacements of upwards of 30,000 tons, with storage space for 3 to 6 million gallons of oil has made possible this intensive exploitation of the whales in Antarctic waters. Some of these ships have provision for hauling the whales on board and for cutting up two whales at the same time, making possible the handling of 15 or more whales per day yielding 1500 barrels (75,000 gallons) of oil. The fleet of "killers"—smaller swift vessels with speeds of 12 to 15 knots, operate from the factory ship base, returning with a catch of 5 to 9 whales. These catchers safely undertake the capture of any species of whales and can cover a large territory, keeping the factory ship engaged in filling its tanks with oil within the short space of time permitted by weather conditions beyond the great ice barrier. One whaler is reported to have taken 1,350,000 gallons of oil in thirteen days.

As evidence of the rapidity of development of this fishery, the world catch of whales increased from 11,369 in 1919–20 to 28,193 in 1925–26, and 37,674 in 1929–30, and 50,000 in 1930–31, or more than 4 times the number taken in the earlier season. World production of whale oil for these seasons was 20,366,350; 57,626,800; 139,952,100; and 200,000,000 gallons, respectively, the take the last season being nearly 10 times that of the first.

For many years scientists in the United States and Europe familiar with the rise and fall of the whale fisheries in various whaling areas have felt grave concern lest certain of these huge mammals be exterminated and have urged the need for biological studies of the whales and provision

for regulations which should remove this menace. Among our own scientists, the names of a number of such men will occur to you including Evermann, Howell, Palmer, and Townsend. This Society has been particularly active in furthering such a movement. Among the nations which have recognized the need for regulation and have exercised a measure of control over their nationals, are Canada, England, and Norway.

With the recent greatly intensified pursuit of whales in all seas, grave concern has been aroused for fear not only that some of the rarer species might be exterminated but lest the huge investments in this great fishery be jeopardized by the commercial exhaustion of the supply.

As many of my readers may not be familiar with developments abroad, these may be briefly summarized. In 1924 an assembly resolution of the League of Nations provided for the creation of a committee of experts "to prepare a provisional list of the subjects of international law, the regulation of which by international agreement would seem to be most desirable and realisable." In 1925, among the questions recommended by this Committee for examination was the "exploitation of the richness of the sea" and the danger to the Balaenoptera in particular was stressed. In September, 1927, the Council was asked by the Assembly to instruct the Economic Committee to study the question of the protection of marine fauna and to decide with the aid of experts "whether and in what terms, for what species and in what areas, international protection of marine fauna could be established."

"In July 1929, the Economic Committee came to the conclusion that international measures might be contemplated to insure the protection of whales and that such measures were actually urgent." Meanwhile the Norwegian Government had prepared a bill which provided for the observance of certain rules by its whalers throughout the world, for the purpose of ending the incomplete utilization of captured whales. This law became effective June 21, 1929. On April 3, 1930, a Committee of Experts met in Berlin at the request of the Economic Committee to consider the feasibility of international protection of marine fauna, Dr. Remington Kellogg, of the National Museum, being a member. As a result of the work of experts and the Economic Committee, a preliminary draft of a convention was made and submitted on July 3, 1930, to members of the League and non-member states for consideration and suggestions and on receipt of replies was subjected to further consideration and revision.

The Conference on the Regulation of Whaling which met in Geneva,

September 9–10, 1931, unanimously adopted a draft convention for the regulation of whaling, the main object of which was to secure the adoption by the greatest possible number of countries of certain rules to prevent the destruction of the whaling industry as a source of wealth. In view of the fact that this Convention differed only in certain minor points without substantial change from the one communicated to the members of the League and non-member states on July 3, 1930, it was decided to open said Convention immediately for signatures. This was done on September 19, 1931.

This convention applies only to baleens or whalebone whales and prohibits the taking or killing of right whales, including North Cape whales, Greenland whales, southern right whales, Pacific right whales, and southern pigmy right whales. It also prohibits the taking or killing of calves, immature whales and females accompanied by calves. The convention demands the fullest possible use of the carcasses of the whales taken, that all plants whether on shore or afloat shall be adequately equipped for the extraction of oil from the blubber, flesh and bones, and at shore stations all residues after the oil is extracted shall be utilized. It urges a change in the method of paying gunners and crews to be based on such factors as size, species, value and yield of oil and not merely on the number of whales taken. The convention also requires the licensing of vessels engaged in whaling, the collection of biological information as to date and place of capture, species, sex, length, length and sex of foetus if present, and stomach contents where practicable and certain statistical information such as number of whales of each species taken, the amount of oil of each grade and the quantities of meal, scrap and other products produced therefrom.

On April 10, 1929, the Whaling Committee of the International Council for the Study of the Sea recommended that a request be made of the Norwegian Government to organize a central institution to collect statistics from the whaling industry throughout the world and on August 16, 1929, the Norwegian Government appointed such a committee. In 1930 an International Bureau for Whaling Statistics was founded at Oslo, to report such statistics regularly, and two reports have been issued. The whaling convention recognizes this bureau and provides that each of the high contracting parties shall communicate statistical information to it. The Convention applies to all the waters of the world including both high seas and territorial waters. "This does not imply any restrictions of the sovereign rights of states within the territory, for which they may, should they so desire, enact any provisions they consider use-

ful, these provisions being added, if necessary, to those resulting from the convention." The convention was to become effective subject to the ratification or accession of eight countries, including Norway and Great Britain. An official despatch from Geneva dated April 18, 1932, states that the following states have signed the convention: Albania, Belgium, Czechoslovakia, Denmark (with a temporary reservation with respect to Greenland), Finland, Germany, Italy, Mexico, Netherlands including Netherlands East Indies and the Netherlands West Indies, Poland, Rumania, Switzerland, Turkey, United States and Yugoslavia, and it is informally understood that ratifications by Great Britain and Norway are to be expected shortly. These are necessary for the convention to become effective.

On March 20, 1931, the Special Committee on Wild Life Resources, United States Senate, held a hearing on the Conservation of Whales and other Marine Mammals, which was printed and copies of which may be obtained from that committee. Senator Norbeck of the committee, who presided, has been especially interested in the subject. The report includes testimony given by Dr. Brazier Howell, Dr. Remington Kellogg, Dr. T. S. Palmer, and the writer. The Bureau of Fisheries is very appreciative of the helpful support received from this Society and from Senator Norbeck in emphasizing the importance of this convention and obtaining the signature of the United States.

As previously stated the production of whale oil has increased from 20 million gallons to 200 million gallons in a decade. The fats and oils market is passing through one of the severest depressions in its history. Whale oil storage tanks are filled, the market is overstocked, prices are extremely low and every effort has been made to restrict whaling operations. Conditions are therefore very favorable for the ratification of the convention, with a minimum of opposition from the industry itself. Those with heavy investments in whaling and those dependent on the industry as a livelihood should realize the wisdom of such action, if for no other reason than for their selfish interests.

International conventions for the conservation of aquatic resources are not new to our government. The subject of pelagic sealing in the waters of the North Pacific Ocean was finally settled on July 7, 1911, by an agreement known as the North Pacific Sealing Convention between the United States, Great Britain, Japan and Russia. Under the protection afforded by this convention it has been possible to build up the herd of fur-seals breeding on the Pribilof Islands from 125,000 animals to about 1,125,000, an increase of one million in twenty years and at the

same time now making possible an annual killing of over 50,000 surplus males.

On October 21, 1924, we ratified a convention with Great Britain for Canada for the regulation of the halibut fishery of the North Pacific which has been yielding over 50,000,000 pounds per annum and which was seriously jeopardized by over exploitation. To provide a simpler more responsive system of control over this fishery a revised convention with Canada became effective on May 9, 1931. Excellent progress has been made in making a thorough study of the halibut fishery in all its aspects and putting into effect regulations by which it is hoped to check further depletion and maintain this fishery at a high productive level for the benefit of the two nations. This convention with Canada represents the first attempt to maintain a great high seas fin fishery through the medium of international agreements.[1]

The signature by the United States of the whaling convention is a further demonstration of its faith in the efficacy of such procedure. As soon as England and Norway have ratified the whaling convention it will be important to obtain the approval of the Senate and secure the passage by Congress of necessary enabling legislation to render the convention effective.

United States Bureau of Fisheries.

[1] The "Convention for the Regulation of Whaling," a multilateral convention, which was signed by the United States at Geneva on March 31, 1932 and also by the respective plenipotentiaries of Albania, Germany, Belgium, Great Britain and Northern Ireland, Canada, Australia, New Zealand, Union of South Africa, India, Colombia, Denmark, Spain, Finland, France, Greece, Italy, Mexico, Norway, Netherlands, Poland, Rumania, Switzerland, Czechoslovakia, Turkey, and Yugoslavia, was approved for ratification by the Senate of the United States on June 10, 1932.

For the full text of the Convention see Congressional Record, June 10, 1932, pp. 12955–12958.

A PLEISTOCENE BAT FROM FLORIDA

By Glover M. Allen

In 1922, Mr. C. P. Singleton of Melbourne, Brevard County, Florida, reported to the United States National Museum the discovery of mammalian fossils at that locality, in part on property owned by himself. In the following year the late Dr. J. W. Gidley of the National Museum and Professor Frederic B. Loomis of Amherst College, examined the locality and spent six weeks investigating the deposit, with Mr. Singleton's assistance. They later (1926) published an account of the occurrence of human remains here, and in the same year Wythe Cook reported on the general geological relations. Mr. Singleton made further collections partly in cooperation with the National Museum and the Museum of Comparative Zoology. It had been planned that Gidley should prepare a final paper on this material but his death has unfortunately prevented this, and a part of the collection has since been turned over to the latter museum as its share of the fossils recovered. No account of these has appeared beyond a few notes by G. G. Simpson and an earlier summary statement of the work done at Melbourne and at Vero, about thirty miles to the south. Lately, while the material in the Museum of Comparative Zoology was being sorted over, the jaw of an insectivorous bat was discovered, which is described in this paper.

The geological conditions seem to be the same at Melbourne as at Vero, already well known through the work of Sellards and others. The country is low and flat, nowhere much exceeding twenty feet above sea level. It is part of the east-coast strip bordering the Indian River. "Originally it was swampy, being partially drained by small, sluggish streams. . . . . Recently a large drainage canal has been cut through this area," which reveals that a great part of the district is immediately underlain by stream deposits older than the present-day drainage system and comprising an upper, somewhat barren layer (No. 3 bed) lying unconformably upon an older deposit rather rich in fossil bones (the "bone bed", No. 2). Below these is a layer of coquina (No. 1 bed) believed to be of Pleistocene age. The second layer contains numerous fragments of mammals, representing probably an early-Pleistocene fauna, and including opossum, gophers, vole, muskrat, rabbits, as well as two bears, peccary, camel, bison, horse, two species of tapir, mammoth, mastodon, megalonyx, mylodon, a large armadillo, and chlamythere. The upper bed lacks most of the early fauna though elephant and mastodon still persisted.

The precise situation of the bat jaw here described is unknown, but was doubtless in the earlier bed, and it is stained the same dark brown color as the other fossils. It represents a species apparently allied to *Molossus* and *Eumops*, but the lower molars have less sharp cutting edges and the cusps are not so high. It may be called

Molossides, new genus

Type species, *Molossides floridanus*, described below.

Generic characters.—With the tooth formula of the lower jaw as in *Molossus*, namely $i._1$ $c._1$ $pm._2$ $m._3$ thus with one less incisor than *Eumops*, except that the small species, *Molossops temminckii*, seems regularly to have but one in each jaw. The incisor is very small, and is contained in a socket not confluent with that of the canine, although close to it against the anterior side; premolars two, the anterior slightly the smaller, both double-rooted, with the alveoli in a plane forming a considerable angle to the tooth row, as in *Molossus*, the outer alveolus of each pair slightly the smaller. In crown view the three lower molars resemble those of *Molossus* in the nearly equal-sidedness of the anterior triangle, which is smaller than the posterior, but the styles are less obvious. First and second molars subequal; the third much narrower, its posterior heel turned obviously outward and narrower than the anterior triangle, but with both its hypoconid and its entoconid large and equally developed. In external aspect the crowns of the molars are seen to be lower and much less trenchant than in *Molossus* and *Eumops*, the hypoconid about one-third less than the height of the protoconid. The entire tooth is longer in proportion to its height, with a wider valley separating the hypoconid from the main shaft of the protoconid.

The species may be known as

Molossides floridanus, new species

Type.—A left lower jaw, perfect anteriorly, but lacking the teeth anterior to the molars, as well as the condyle and angle of the jaw; no. 17672, Museum of Comparative Zoology (Cat. Fossil Mammals), from (probably) the earlier Pleistocene deposit, no. 2 Bed, at Melbourne, Brevard County, Florida; C. P. Singleton, collector.

Description.—The obvious differential characters have already been mentioned as points of generic value. The first molar has the paraconid placed well forward, and its anterior edge has a characteristically convex middle portion. The paraconid and metaconid are of equal height and both show their tips clearly in side view at each side of the protoconid, instead of being nearly hidden by it as in *Molossus* and *Eumops*. A pronounced but low cingulum runs along the outer edge of each molar from just below the tip of the paraconid to the base of the hypoconid. The latter is practically equal in size to the entoconid in each of these teeth. The crown view shows the rather blunt inner styles, the peculiar outwardly bent posterior lobe of the third molar, and the nearly equalsided triangle formed by the three anterior cusps of each.

Comparisons.—Of American bats the only genera having the same tooth formula as *Molossides* are: *Noctilio*, *Mimon*, *Molossus*, and *Molossops* (only in

the small species, *Molossops temminckii*). Of these, *Noctilio* is at once excluded by the very different shape of its molars; in crown view the two triangles composing each tooth are much compressed antero-posteriorly, so that each forms an isosceles instead of an equilateral triangle, the posterior one higher than the anterior one in m_1 and m_2, but both of about equal size in m_3. The first premolar is small and with but a single root, apparently that of the inner side. It is thus a wholly different type of jaw.

In *Mimon*, again, one of the Phyllostomidae, the narrow isosceles triangles composing the first and second molars, contrast with the nearly equilateral triangles of *Molossides*, while in m_3 the posterior heel is very much reduced, scarcely equalling the protoconid in crown view, and with the hypoconid and entoconid so small and so close together as scarcely to be distinct. In side view

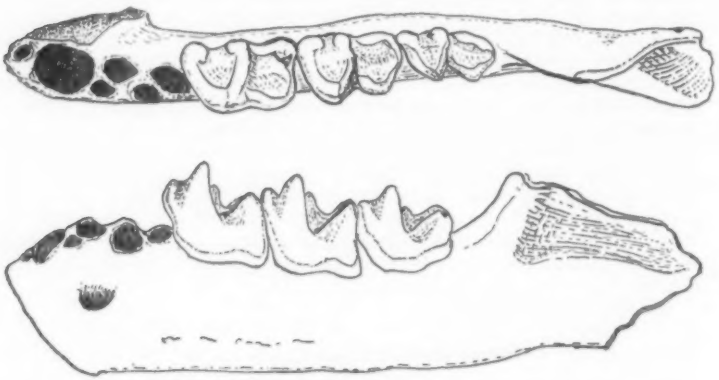

FIG. 1. *Molossides floridanus*, n. sp. Upper: crown view of the type jaw; lower: lateral view of same, from the exterior, showing the alveoli of the incisor, canine, and two premolars. × about 6.

the paraconid is smaller with less anterior projection. The two premolars are not crowded, and the second appears to have two roots on the outer side of the jaw, one directly behind the other. Very different too is the alveolus of the canine, which extends ventrally on the front aspect of the chin well below the level of the other sockets.

The jaw of *Molossides* is larger than that of the largest known species of *Molossus*, and compared with that of *Molossus obscurus* it shows a number of differences. In the latter species the anterior triangle (in crown view) of the two anterior molars is obviously smaller than the posterior, with its lingual side (base) shorter than its two other sides, forming thus an isosceles triangle, whose commissures are more trenchant than the rather blunt cusps of the fossil species. This is obvious also in side view, for whereas in *Molossus* the hypoconid is nearly

as high as the protoconid in the anterior two molars, in *Molossides* the posterior cusp is markedly lower and separated from the protoconid by a wider valley.

Measurements.—The total length of the jaw fragment is 17.5 mm.; from anterior tip of jaw to back of m_3, 11.5; depth of mandible at front of m_1, 3.4; length of m_1, 2.5; of m_2, 2.5; of m_3, 2.3; combined greatest length of molars $_{1-3}$, 7.3; height of m_1, from outer base to tip of protoconid, 2.6. It is unfortunate that the angle of the mandible is broken away, but the slope of the base of the coronoid process indicates that it was low as in *Molossus* and allied genera.

The relationship of this bat is evidently with *Molossus*, and its presence with remains of other mammals characteristic of a warm climate may indicate that it was a subtropical species.

LITERATURE CITED

Cook, Wythe. 1926. Fossil man and Pleistocene vertebrates in Florida. Amer. Journ. Sci., ser. 5, vol. 12, pp. 441–452.

Gidley, James W., and Frederic B. Loomis. 1926. Fossil man in Florida. Amer. Journ. Sci., ser. 5, vol. 12, pp. 254–264.

Simpson, G. G. 1929. Pleistocene mammalian fauna of the Seminole Field, Pinellas County, Florida. Bull. Amer. Mus. Nat. Hist., vol. 56, pp. 561–599.

A NEW SHREW OF THE SOREX MERRIAMI GROUP FROM ARIZONA

By E. Raymond Hall

[*Plate 13*]

In the summer of 1931, while seeking topotypes of mammals in southwestern United States, Miss Annie M. Alexander and Miss Louise Kellogg obtained two shrews of the little known *Sorex merriami* group from the Graham Mountains of Arizona. A third specimen was taken by Miss Alexander on Rose Peak, Arizona. These three specimens mark, for this group, an extension of range of more than four hundred miles to the southward and increase the number of known specimens to eleven. For an account of the eight specimens previously known, reference should be made to pages 78 to 82 of Dr. Hartley H. T. Jackson's "A Taxonomic Review of the American Long-tailed Shrews," North American Fauna, no. 51, 1928, which now, of course, forms the starting point for any additional systematic work on the genus *Sorex*.

The specimens from the Graham Mountains represent a new species which may be known as

Sorex melanogenys, new species

pl. 13, figs. a to f

Type.—Male adult, skin and skull; no. 50247, Mus. Vert. Zool.; Marijilda Canyon, 8600 feet altitude, Graham Mountains [= Pinaleno Mountains], Graham County, Arizona; July 3, 1931; collected by Annie M. Alexander; original no. 924.

Diagnosis.—A species of the *Sorex merriami* group as defined by Jackson (North Amer. Fauna no. 51, p. 78, 1928); size about as in *Sorex leucogenys*; upper parts near fuscous (color terminology after Ridgway, Color Standards and Color Nomenclature, 1912); underparts blackish, overlain with light wash of buffy brown and only slightly lighter than upper parts; feet brownish, not grayish;

Measurements, in millimeters, of four specimens of the Sorex merriami group
Comparisons should be made with measurements given by Jackson (*op. cit.*, p. 82)

	MUS. VERT. ZOOL. CATALOG NO.	TOTAL LENGTH	LENGTH OF TAIL	LENGTH OF HIND FOOT	CONDYLOBASAL LENGTH	PALATAL LENGTH	CRANIAL BREADTH	LEAST INTERORBITAL BREADTH*	MAXILLARY BREADTH	MAXILLARY TOOTHROW	WEAR ON TEETH
Sorex melanogenys, type	50247	107	42	13	16.7	6.7	8.4	3.4	4.7	6.2	Moderate
Sorex melanogenys, topotype	50249	106	41	12	16.6	6.7	8.6	3.4	4.9	5.9	Moderate
Sorex (merriami?), Rose Peak, Arizona	50244	95	34	12	16.4	6.7	—	3.7	5.0	5.9	Slight
Sorex leucogenys, Chiatovich Creek, 8200 feet, Esmeralda Co., Nev.	38398	97	36	12	16.5	6.9	8.4	3.7	5.3	6.1	Moderate

* Least interorbital breadth as given above seems to be less on any given skull than is the "Interorbital breadth" of Jackson (N. Am. Fauna, no. 51, 1928).

tail indistinctly bicolor, brownish beneath; brain case shallower than in *leucogenys* and narrower than in either *leucogenys* or *merriami*; third and fourth unicuspids of practically same size; fifth unicuspid, in occlusal view, more than half the size of the fourth; unicuspid tooth rows straight and converging anteriorly.

Material.—Two specimens from the type locality.

Comparison.—*Sorex melanogenys* differs from both *S. merriami* and *S. leucogenys* in darker color of the tail, feet, and underparts, and in having the fifth unicuspid more than, rather than less than, half the size of the fourth unicuspid. From *merriami* it is further distinguished by larger skull and straight, rather than bent, rows of unicuspids. These two characters of *melanogenys* appear to be ones held in common with *leucogenys*. The shallower brain case than *leucogenys* is more like the condition in *merriami*.

Remarks.—Employing Jackson's account (*op. cit.*, p. 78) of the known material

of the *Sorex merriami* group and one specimen from Chiatovich Creek, 8200 feet, Esmeralda County, Nevada, identified by him (p. 82) as *Sorex leucogenys*, I feel no hesitancy in diagnosing the two specimens from the Graham Mountains as a new species. However, in the absence of actual specimens of *Sorex merriami*, and in view of the small number of known specimens of all species in the group, I am in doubt about the systematic worth of certain observed characters. One of these is the size of the fifth unicuspid which in each of our two specimens is, in occlusal view, approximately three-fourths the size of the fourth unicuspid. In our specimen of *leucogenys* from Esmeralda County, Nevada, the fifth unicuspid is not more than one-fourth as large as the fourth. In so far as can be judged from figure 6 of plate 23 in Dobson's Monograph of the Insectivora (1890) and from Jackson's illustrations (pl. 7, figs. I and J), this small size of the fifth unicuspid obtains also in the type specimens of *leucogenys* and *merriami*. Nevertheless, one is not certain but that individual variation may bridge these differences.

Similarly, it is not altogether clear what systematic value attaches to the straight versus curved or bent condition of the unicuspid tooth row. The available specimen of *leucogenys* from Chiatovich Creek, Nevada, differs from Jackson's characterization of that species (p. 81) in having the anterior halves of the unicuspid tooth rows approximated and nearly parallel. This is a character ascribed by Jackson to *S. merriami* as in part distinguishing it from *leucogenys*.

Mention now may be made of another, heretofore unrecorded, specimen of the *Sorex merriami* group. This is an adult male, skin and skull; no. 50244, Mus. Vert. Zool.; from Rose Peak, 8700 feet altitude, Greenlee County, Arizona; obtained June 25, 1931, by Annie M. Alexander. The locality represented is only seventy-five miles or so north and east of the type locality of *Sorex melanogenys*, but the specimen cannot be referred to *melanogenys*. It has more of the characters of the geographically farther removed species *merriami* and *leucogenys*, though it does not entirely agree with either. The feet, underside of tail, and underparts of the body, though much lighter than in *melanogenys*, are notably darker than in the specimen of *leucogenys* from Esmeralda County, or assumedly, than in *S. merriami*. External measurements of the specimen from Rose Peak are less than in either *melanogenys* or *leucogenys* and about as in *merriami*. The maxillary breadth is about as in *merriami* and *leucogenys* and greater than in *melanogenys*. The brain case is deeper than in *melanogenys*, shallower than in *leucogenys*, and thus, probably, about as in *merriami*. The occlusal area of the fifth unicuspid is only about one-fourth as large as that of the fourth unicuspid. In this respect the animal differs from *melanogenys* and seems to agree with *leucogenys* and *merriami*. The five unicuspids are arranged in a straight line and the two rows are not parallel or approximated in their anterior half as in our specimen of *leucogenys* or as described in *merriami*. The molars appear to be a little narrower than in *leucogenys* and are about as in *melanogenys*.

Because of the combination of characters presented by this individual, from Rose Peak, I am not certain whether it should be regarded as an unnamed form, as a representative of one of the previously named species of the *Sorex merriami* group, or as an intergrade between *Sorex melanogenys* on the one hand and *Sorex leucogenys* or *Sorex merriami* on the other. For the present it is tentatively assigned to *Sorex merriami*.

The two specimens of *Sorex melanogenys*, along with three specimens identified by Dr. H. H. T. Jackson as *Sorex vagrans monticola*, were taken in a line of traps set under dead brush and in runways of *Microtus*, among skunk cabbage, sedge, and grasses along the margin of the creek at 8600 feet altitude in Marijilda Canyon. Here the stream was bordered by a dense stand of fir and spruce, with but little undergrowth.

That part of Jackson's key which would require modification to include *Sorex melanogenys* involves lines 13 to 24 (p. 33) inclusive. This part of the key might now stand as follows:

g¹. Hind foot 13 or more; palatal length less than 6; known geographic range confined to Pribilof Islands, Alaska ..... *pribilofensis* (p. 76).

g². Hind foot 13 or less; palatal length more than 6.

h¹. Condylobasal length less than 16.4; cranial breadth less than 8.1 *merriami* (p. 78).

h². Condylobasal length more than 16.4; cranial breadth more than 8.1.

i¹. Underparts distinctly whitish; maxillary breadth more than 5; crown face of fifth unicuspid less than half that of fourth. . *leucogenys* (p. 81).

i². Underparts scarcely lighter than upper parts; maxillary breadth less than 5; crown face of fifth unicuspid more than half that of fourth *melanogenys*.

Museum of Vertebrate Zoology, University of California, Berkeley, California.

EXPLANATION OF PLATE 13

Photographs of skull of *Sorex melanogenys*, type, male, adult; no. 50247, Mus. Vert. Zool.; Marijilda Canyon, Graham Mountains [= Pinaleno Mountains], Graham County, Arizona; July 3, 1931; collected by Annie M. Alexander; original no. 924.

a. Dorsal view, x¹.
b. Ventral view, x¹
c. Lateral view, x¹.
d. Lateral view, x²
e. Dorsal view, x²
f. Ventral view, x²

TYPE SKULL OF SOREX MELANOGENYS HALL

UNIV. OF MICH.

HYAENOGNATHUS FROM THE LATE PLIOCENE OF THE COSO MOUNTAINS, CALIFORNIA

By Chester Stock

[*Plate 14*]

Of the several occurrences of *Hyaenognathus* in the Pliocene and Pleistocene of North America three are recorded from California, one from the valley of Mexico, and one from Nebraska. To this list is now added a fourth occurrence in California based on a specimen from late Pliocene beds, exposed on the western flanks of the Coso Mountains, Inyo County, California.

While relatively few mammalian forms are now known from these deposits the fauna includes, in addition to *Hyaenognathus*, a new type of vole (*Cosomys* Wilson), a mastodon, *Plesippus* or *Pliohippus*, and a peccary.

Hyaenognathus solus new species

Type specimen.—No. 481, comprising chiefly the palatal portion of a skull with the superior dentition, plate 14, A and B.

Specific characters.—Resembling *Hyaenognathus matthewi* Freudenberg more closely than *H. dubius* Merriam (*H. pachyodon* Merriam). Differing from *H. matthewi* in smaller I^1, less spacing of P^2 and P^3, and in greater forward direction of inner anterior root of P^4.

Locality.—Calif. Inst. Technology Vert. Paleont. Loc. 131, Coso Mountains, 9½ miles east of Olancha, Inyo County, Calif.

This specimen is somewhat more complete than the type of *Hyaenognathus matthewi* described by Freudenberg[1] from the Valley of Mexico. Our type is somewhat smaller than a cast of *H. matthewi*. There is likewise not much difference in this character between No. 481 and the skull fragment of *Hyaenognathus dubius* Merriam from Contra Costa County, California.[2]

In No. 481 all of the incisors with the exception of I^2 are represented. As in the described species these teeth have strong, broad crowns, and I^3 is distinctly larger than I^2. A narrow basal tubercle or cingulum is situated at the inner posterior base of the principal cusp in I^3. In *H. matthewi* the third incisor, judged in the light of its alveolus, was probably larger than in No. 481. In relative size of I^3 No. 481 is more like *H. dubius*. Evidently associated with the smaller size of I^3 is the slightly longer diastema between I^3 and the canine in the specimen from the Coso Mountains than in the Mexican species. The crown of the canine is

[1] Freudenberg, W., Geol. u. Palae. Abh., vol. 13, pp. 209–214, pl. 24, figs. 3, 4, 1910.

[2] Merriam, J. C., Univ. Calif. Publ., Bull. Dept. Geol., vol. 3, pp. 283–288, pl. 30, fig. 1, 1903.

relatively short and slender. It is sharply ridged anteriorly and posteriorly and these ridges define an outer and an inner surface. The former is broadly convex while the latter face is flatter with a median convexity extending the length of the crown.

No. 481 is distinctly more like the Mexican species and differs from *Hyaenognathus dubius* in the position of the anterior premolars. As in *H. matthewi*, the alveolus for P^1 is situated farther forward with reference to the posterior border of the canine alveolus and more to the inner side than in *H. dubius*. Moreover, while in the latter P^2 and P^3 are in alignment with an axis extending from the anterior end of P^4 to the posterior end of the canine, these teeth in No. 481 and in Freudenberg's specimen are distinctly oblique to this axis. In No. 481 the posterior end of P^2 overlaps the antero-external surface of P^3 and the two teeth are situated close together, whereas in the Mexican form the two premolars are separated by a short space.

The crowns of P^2 and especially P^3 are slightly narrower relatively to their long diameters than in Freudenberg's material. In contrast to P^4, whose crown is considerably worn, the occlusal surfaces of P^3 and P^2 show practically no wear. Both crowns are better preserved than in the Mexican species. In both teeth the principal cusp and posterior basal cuspule are greatly subdued. The principal cusp tends to form a low ridge which extends to the anterior end of the tooth. A cingulum is present along the inner base of the crown in P^3 and P^2. In the type of *H. matthewi* the principal axis of P^3 extends more directly transverse with reference to the anteroposterior axis of the palate than in the Californian form.

P^4 agrees with the comparable tooth in *H. matthewi* and *H. dubius* in heaviness of shearing blade and absence of protocone. A parastyle is absent, the only indication of this structure being a short low ridge situated on the anterior surface of the paracone near the base. No. 481 is more like *H. dubius* and differs from *H. matthewi* in the extent to which the antero-internal root carries its crown in front of the anterior margin of the paracone. In the latter species the root does not project forward and P^3 overlaps the anterior border of the protoconal region.

In the molar series considerable discrepancy in size is seen to exist between M^1 and M^2. The smallness of the posterior molar and anterior premolars gives added prominence to the intervening teeth, namely P^4 and M^1. The characters of the first molar are similar to those noted by Merriam in the comparable tooth of *H. dubius*. In No. 481 the shoulder at the antero-internal angle of the tooth is formed by a short cingulum. The fragmentary first upper molar of *Hyaenognathus* from the Tehama formation of northern California[3] is smaller than the comparable tooth in No. 481. The crown of the second molar in the specimen from the Coso Mountains is characterized by a relatively broad central basin.

In *H. matthewi* the borders of the anterior palatine foramina are not preserved. These foramina in No. 481 are relatively small for the size of the palate. A well defined groove extends forward for some distance from each foramen. A single postpalatine foramen is present on each side of the palate on a level slightly in advance of the anterior borders of the first upper molars. Two foramina are

[3] Russell, R. D. and Vander Hoof, V. L., Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 20, p. 19, fig. 7, 1931.

A

B

Hyaenognathus solus, new species; A, ventral view of rostrum, B, lateral view of rostrum. × ¾. Cat. no. 481, Calif. Inst. Technology. Coll. Vert. Paleont.; Upper Pliocene, Coso Mountains, Calif.

UNIV. OF MICH.

present on each side in *H. dubius*, but the openings have approximately the same position as in No. 481. The facial portion of the skull anterior to the fourth premolars is laterally constricted and as seen in side view (Plate 14, fig. B) the anterior opening of the infraorbital canal lies in the recessed wall of the maxillary above P^3.

Of the several species of *Hyaenognathus* recorded from the Pliocene and Pleistocene two in addition to the one here described are known by the facial portion of the skull and upper dentition.[4] In the position of the anterior premolars the form from Coso Mountains resembles *H. matthewi* more than it does *H. dubius*. The principal differences between the Mexican type and No. 481 lie in the spacing of P^2 and P^3, the more transverse position of the third premolar, less forwardly directed protoconal root of P^4, and possibly larger size of I^3. Notwithstanding these differences the two forms are closely related. *H. dubius* differs from No. 481 in the position of the anterior premolars and less forwardly directed protoconal root of P^4.

While *H. matthewi* is recorded from the marls of Tequixquiac and has been regarded as of Pleistocene age, there is evidently some question as to the geologic horizon whence this specimen comes. Freudenberg has stated that the species is characteristic of the deepest strata at Tequixquiac which Felix and Lenk consider of upper Pliocene age. From the same horizon are recorded *Aphelops* and *Preptoceras*. The presence of the rhinoceros would further suggest a Pliocene age but the bovid genus *Preptoceras* has been found elsewhere only in typical Pleistocene faunas.

Measurements (in millimeters) of No. 481

Length from anterior end of premaxillary to median point of palatine border of posterior nares	108.5
Width of snout between outer alveolar borders of upper canines (approximate)	56.5
Width of face between maxillary surfaces covering outer anterior roots of upper carnassials	90
Width of palate between canines	35.3
Least width of palate between first molars	39
Width across incisors measured between outer surfaces of lateral incisors	39
I^2, transverse diameter	6.5
I^2, anteroposterior diameter	8.3
I^3, transverse diameter	8.3
I^3, anteroposterior diameter	10
C, anteroposterior diameter at base of enamel	15.2
C, transverse diameter at base of enamel	10.9
P^2, greatest length	9.2
P^2, greatest width	5.3

[4] While the type of *H. pachyodon* consists of a lower jaw, topotype material recently secured by Mr. Vander Hoof at the locality near McKittrick, has been regarded by Matthew and Stirton as presenting sufficient evidence to indicate that *H. dubius* is specifically identical with *H. pachyodon*.

P^3, greatest length	11.1
P^3, greatest width	6.4
P^4, anteroposterior diameter through middle of tooth	27.8
P^4, transverse diameter across protocone	14.6
M^1, anteroposterior diameter	16.2
M^1, greatest transverse diameter normal to plane of outer surface	21.9
M^2, greatest anteroposterior diameter	8.1
M^2, greatest transverse diameter	11.8

Balch Graduate School of the Geological Sciences, California Institute of Technology.

A NEW BEAVER FROM ARIZONA

By E. A. Goldman

The beavers of Arizona have usually been assigned by recent authors to *Castor canadensis frondator*, which was described from the San Pedro River, Sonora, near the Arizona boundary. The material available for study is rather meager, but comparisons indicate that a hitherto unrecognized geographic race occurs along the Colorado River.

The new subspecies is described as follows:

Castor canadensis repentinus subsp. nov.

COLORADO RIVER BEAVER

Type.—From Bright Angel Creek, Grand Canyon of the Colorado River, Arizona (altitude 4,000 feet); no. 161613, ♀ adult, U. S. National Museum (Biological Survey collection); collected by Clarence Birdseye, September 14, 1909; original number 723.

Distribution.—Vicinity of the Colorado River from the Grand Canyon to the delta; limits of range unknown.

General characters.—A light-colored subspecies closely allied to *Castor canadensis frondator*, of southeastern Arizona and northeastern Sonora, but upper parts paler, yellowish cinnamon, instead of near pecan brown (Ridgway, 1912) as in the type; cranial characters, especially the long nasals, distinctive. Similar to *C. c. baileyi*, of Nevada, but slightly paler, upper parts more yellowish, less rufescent; skull decidedly broader. Differing from *C. c. mexicanus*, of New Mexico, in slightly yellower coloration (duller brownish in *mexicanus*) and in cranial details, especially the longer, less expanded nasals.

Color of type.—Upper parts in general yellowish cinnamon, purest on rump and upper base of tail, this tone due to the long guard hairs overlying the under fur, which is near mars brown (Ridgway, 1912); flanks somewhat lighter than back; sides of muzzle, cheeks, sides of neck, forearms, and forefeet between pinkish

buff and cinnamon buff; under parts pale cinnamon buffy, becoming darker and near mikado brown along the median line of abdomen, varying to hazel on anal region and base of tail and to liver brown on hind feet, probably due to staining; tail brownish and naked as usual in the group.

Skull.—Similar in size to that of *C. c. frondator*, but rostrum less flattened; nasals longer, extending farther posteriorly beyond premaxillae; premaxillae narrower posteriorly; frontal region broader anteriorly; zygoma heavier, the lower border directed more strongly downward anteriorly, with a more prominent anterior angle; jugal more extended vertically at postorbital process; lambdoid crest less projecting posteriorly over condyles, so that occipitonasal length is slightly exceeded by condylobasal length (in *frondator* the reverse is true); dentition about the same. Also similar to that of *C. c. baileyi*, but braincase, rostrum, and nasals decidedly broader; zygomata more widely spreading. Compared with *C. c. mexicanus* the nasals are longer and narrower, less inflated; premaxillae usually narrower posteriorly; jugal less extended vertically at its postorbital process; bullae more smoothly rounded, broader, more fully inflated anteriorly.

Measurements (type): Total length, 1,132 mm.; tail vertebrae, 453; hind foot, 185. An adult female topotype: 1,000; 390; 176. *Skull* (type): Occipitonasal length, 135.4; condylobasal length, 136.4; zygomatic breadth, 95.5; greatest width of frontals (just behind lachrymals), 41.6; interorbital constriction, 24.6; width of braincase (at squamosal constriction behind zygomata), 44.9; length of nasals, 53.9; greatest width of nasals, 24; maxillary toothrow, 32.7.

Remarks.—*Castor canadensis repentinus* appears to be most closely allied to *C. c. frondator* of southeastern Arizona, but the elongation of the nasals and other cranial details also suggest relationship to *C. c. baileyi* of the interior plateau region of Nevada. Specimens from near Yuma, Arizona have shorter nasals and probably grade toward *frondator*, but in the massive jugal and other respects seem nearer to *repentinus*. At the type locality the beavers inhabit Bright Angel Creek, which in short reaches descends the terraced north side, below the outer rim, of the Grand Canyon. None are known from the Colorado River in that vicinity, and a measure of isolation would seem to be due to the rapids and heavy current through rock-bound gorges extending for many miles, and affording very few places suitable for beavers to establish homes.

Specimens examined.—Four, all from Arizona, as follows: Bright Angel Creek, Grand Canyon (type locality), 2; Yuma (15 miles south), 2 (skulls only).

United States Biological Survey, Washington, D. C.

PRELIMINARY DESCRIPTION OF TWO NEW PALEARCTIC VOLES

By Anatol I. Argyropulo

Microtus (Stenocranius) gregalis montosus new subspecies

Microtus (Stenocranius) eversmanni Polyakoff (subsp?) Vinogradov, Abhandlungen der Pamir-Expedition, VIII, 1928, Mammalia, p. 3, Leningrad.

Type.—No. 17946, Zool. Mus. Russ. Acad. Sci. (USSR); adult male; collected by A. N. Reichert, June 30, 1928.

Type locality.—Sary-Tash, Alai Valley, Russian Turkestan.

Range.—Alai Valley (Sary-Tash and Bor-Doba) and mountains of Transalai, Kzylart, Russian Turkestan.

Characters.—A relatively large mountain form, one of the most lightly colored, with a long tail and a summer pelage denser and longer than in other subspecies of *M. gregalis.*[1]

Color of the upper part of the body very light, as in *M. gregalis ravidulus* Miller, but particularly the intensive rufous suffusion characteristic of *ravidulus* is wanting; belly whitish with a slight dirty-cream shade. Length of hair in the middle part of the back, 15–17 mm. (in July). Skull large and massive; zygomatic breadth relatively small; brain case and rostrum high, as in *ravidulus*; auditory bullae relatively large and swollen.

Measurements of the type.—Head and body, 112 mm.; tail, 30.4, hind foot, 15.7; ear, 11.5. Condylobasal length of the skull, 27.6; zygomatic breadth, 14.4; breadth of brain case, 12; diastema, 8.7; interorbital breadth, 2.8; upper molar series (alveoli), 6.6.

Remarks.—We must consider the described form as the most lightly colored of all three southern races of *Microtus gregalis—raddei* Polyakoff, *ravidulus* Miller, and *montosus*. It differs from the darkest of these forms not only by its color but also by larger size of body and skull. The described form differs from *ravidulus* by the absence of bright rufous tints in the coloring of the pelage and by a shorter tail. Longer hair in summer pelage also differentiates *montosus* from both other races. From *Microtus gregalis castaneus* Kashkarov and *M. g. eversmanni* Polyakoff (= *tianschanicus* Büchner) the described form hardly differs by its light color.

Microtus (Microtus) colchicus new species

Type.—No. 70-1922-244, Zool. Mus. Russ. Acad. Sci. (USSR); adult female; collected by B. S. Vinogradov, August 12, 1915.

Type locality.—Tamarascheni, Gori dist., Georgia, Transcaucasia.

Range.—Known only from the type locality.

---

[1] I accept the following forms of *Microtus gregalis* (Pallas), as valid: 1, *gregalis* Pallas (true to type) = *slowzovi* (Polyakoff); 2, *buturlini* Ognev; 3, *kossogolicus* Ognev; 4, *unguiculatus* Vinogradov; 5, *brevicauda* Kashtschenko; 6, *raddei* Kashtschenko = *angustus* Thomas; 7, *eversmanni* Polyakoff = *tianschanicus* Büchner; 8, *ravidulus* Miller; 9, *castaneus* Kashkarov; 10, *montosus* subsp. nov.

M. (Stenocranius) major Ognev is apparently a different species which must be separated from *M. (S.) gregalis* (Pallas).

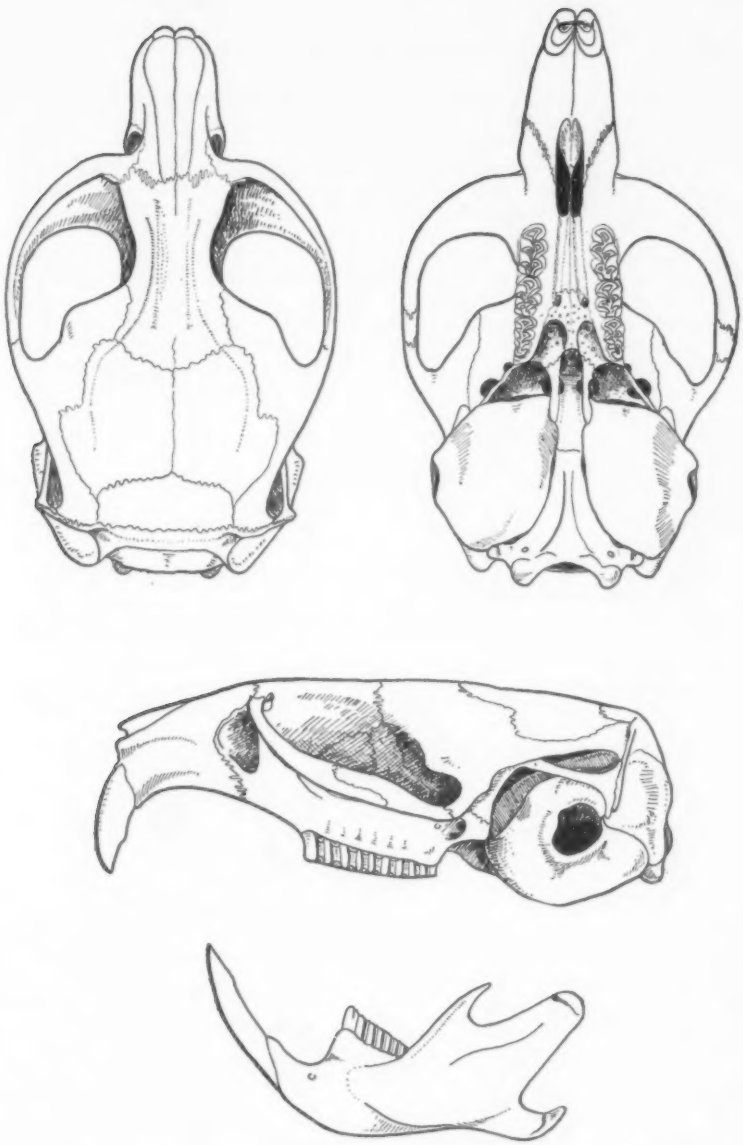

FIG. 1. *Microtus* (*Microtus*) *colchicus* new species (type). About × 3½.

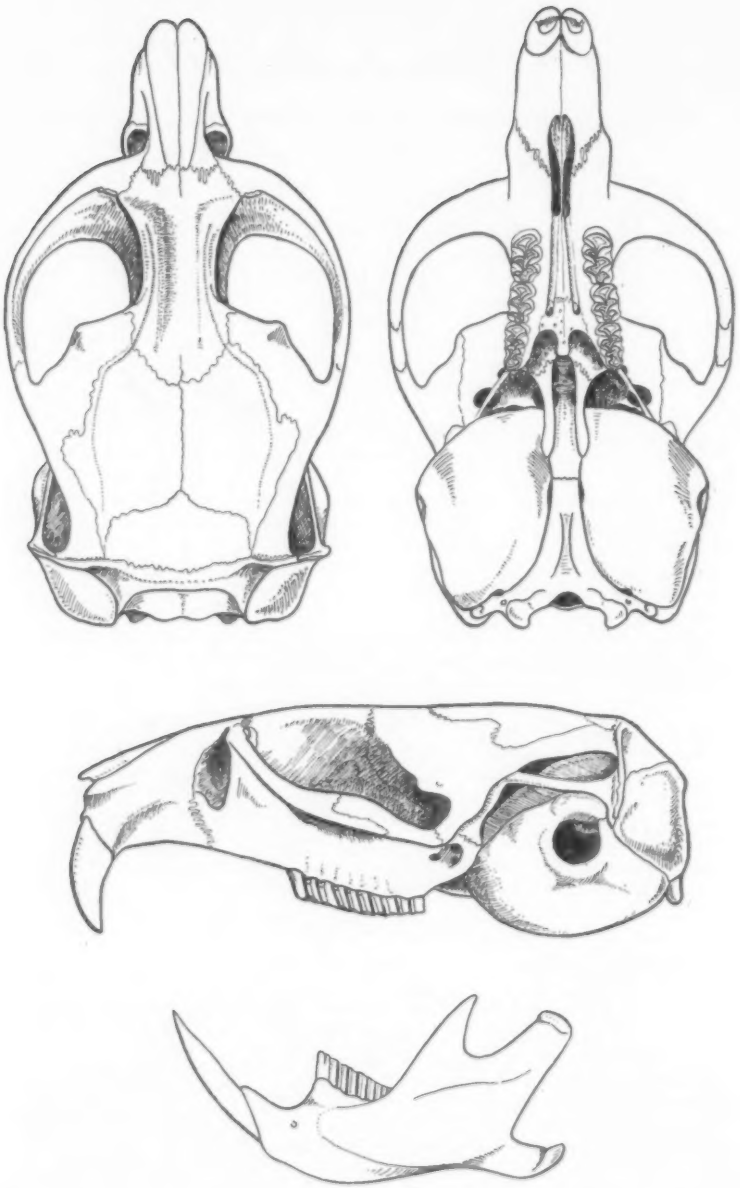

FIG. 2. *Microtus* (*Microtus*) *socialis satunini* Ognev. About × 3¼.

Characters.—The smallest species of the "*socialis*" group; length of the hind foot, 14.4–15.6 mm.; average 15 mm. (in *M. socialis satunini*, 15.9–18 mm.; average 16.7 mm.). Condylobasal length of skull, 25.2; zygomata flattened, their breadth relatively narrow; auditory bullae very small (smaller than in all known forms of *M. socialis* Pallas, including the smallest typical race from the Volga-Ural steppes); mastoids but slightly swollen, their surfaces being flattened; upper incisors more inclined forward than in *M. s. socialis* Pallas, *M. s. cf. socialis* (central Turkestan), *M. s. paradoxus* (Ognev and Heptner) and *M. s. satunini* (Ognev).[2]

Color of the upper part of body a little darker than in *M. s. satunini*, the darkest form of *M. socialis*.

Measurements of the type.—Head and body, 98 mm.; tail, 26.7; hind foot, 15.4; ear, 8.3. Condylobasal length of the skull, 25.2; zygomatic breadth, 15.1; breadth of brain case, 12.5; combined height of brain case and bullae, 9.1; diastema, 7.6; interorbital breadth, 3.7; greatest length of bulla, 8; greatest breadth of bulla, 6.2; upper molar series (alveoli, 6.4).

Remarks.—In some characters the described vole differs rather strongly from all known forms of *M. socialis*. There are no gradations between *M. colchicus* and *M. socialis* (subsp. *satunini*) living in its neighborhood and therefore, before finishing my study on the classification of voles of the group "*socialis*" I describe the new form as a separate species.

This species differs from all races of *M. socialis* (including *guentheri* Danford and Alston and *irani* Thomas), by its small tympanic bullae and the incisors being more inclined forward, and from *M. hartingi* Barrett-Hamilton, *lydius* Blackler, *philistinus* Thomas, and *mustersi* Hinton, by its rather smaller size. *Microtus colchicus* seems to be the smallest species of the whole group.

I add to the description figures of the skull of the type of *M. colchicus* and for comparison one of *M. s. satunini*; the first specimen was obtained at a distance of 70 km. from the second.

Leningrad, U. S. S. R.

[2] S. I. Ognev, "Rodentia of the North Caucasus," 1924. Rostov Don, p. 38. (In Russian.)

GENERAL NOTES

MYOTIS GRISESCENS AND MYOTIS SODALIS IN TENNESSEE AND ALABAMA

The specific characters of *Myotis grisescens* were recognized by Howell in the series of specimens which he secured in Nickajack Cave, in southeastern Tennessee, on August 31, 1908. He states that the bat occurred there in great numbers. He also quotes Holt as saying that thousands of the bats lined the ceiling of Saltpetre Cave, near Rogersville, Alabama, when he visited it June 18th. (Biological Survey of Alabama, N. A. Fauna No. 45, 1921.) Holt collected 62 specimens on that visit.

Howell probably was told by local residents that bats also occupied the cave in great numbers during the winter, and since no other social bat was known from the locality he assumed that it was *Myotis grisescens*. This conclusion seems to have been unquestioned. Miller and Allen (American bats of the genera *Myotis* and *Pizonyx*, U.S.N.M. Bull. 144, 1928) stated that colonies frequent the same caves in both summer and winter. I know of no winter visit made by a naturalist to any cave from which *Myotis grisescens* has been reported. Accordingly, I venture to write at some length on two trips to the type locality, Nickajack Cave, Tennessee, and one visit to Saltpetre Cave, Alabama, the caves in which the largest colonies are supposed to live.

In the first place, the study of these bats in winter presents difficulties, both in getting to the caves and in reaching the bats in the caves. Accompanied by my brother, John L. Mohr, I first visited Nickajack Cave on December 24th, 1931, with Dr. L. S. Ashley, operator of the cave, as guide. He warned us that the bats hibernate on the far side of the stream in this cave, and that in winter there is no means of crossing the stream except by wading.

Investigation showed that the large blackened areas on the ceiling of the chamber, 100 yards from the entrance, where Howell found clusters of bats hanging in summer, were now quite deserted. However we did find a colony of about 300 individuals, hanging in a very low chamber about 200 yards farther on. But the bats here were *Myotis sodalis*, a species which hitherto had been represented in Tennessee only by a single specimen! Nearby I found a solitary *Myotis grisescens*, a female, in the russet phase.

As Dr. Ashley insisted that the major portion of the colony was on the far side of the 60-foot-wide stream I decided to wade across. The stream was at rather high stage but he pointed out a shallow place where the water was only four and half feet deep. His observations proved to be correct. On the far side of the stream, probably 300 yards from the entrance, I found four clusters of bats, each comprising several hundred individuals, as well as numerous solitary animals and small groups. All hung at heights of one to eight or ten feet from the floor, most of them on the water-worn under-surface of huge blocks which lay unevenly on the floor, forming small chambers and passages. With the exception of a few *Pipistrellus subflavus subflavus*, all were *Myotis sodalis*. Flashlight pictures of the colonies were taken. On leaving the cave a few bats could be seen and heard on a darkened ceiling spot at the extreme end of the large room which the bats occupy in summer. A pile of rocks towered near to the bats but Dr. Ashley considered the spot inaccessible.

We returned to the cave January 4th, 1932, climbed to the top of the rock pile and with a fishing pole succeeded in reaching and securing one of the half dozen bats that hung from the ceiling spot. It was *Myotis sodalis*. The others appeared to be the same. An examination of the cave revealed three more specimens of *Myotis griescens*, all males in the dusky phase. There were probably 1200 to 1500 *Myotis sodalis* in the cave. Of twelve specimens picked at random, ten were males, two females. Clusters examined but not counted contained individuals of both sexes.

Late the same day, January 4th, we reached Saltpetre Cave in northwestern Alabama. The four-mile trip from Rogersville is a difficult one as there is the merest semblance of a road. A local boy was our guide and we explored the cave thoroughly, I believe. Large guano deposits were found and the stench was strong. However we located just a dozen bats: one *Myotis griescens*, a male in the dusky phase, three *Eptesicus fuscus fuscus*, three *Pipistrellus subflavus subflavus*, and five *Myotis sodalis*. A single specimen of the last species had been reported previously for Alabama.

In conclusion, then, it is reasonably certain that *Myotis griescens* does not hibernate in its summer quarters in any great numbers. Its status as the common bat in summer, however, seems unaffected. During the summer, *Myotis sodalis* may be as completely absent from its winter haunts in the caves of Tennessee and Alabama as it seems to be in Pennsylvania caves. This conclusion seems valid since no specimens of *Myotis sodalis* were found in the large summer series taken at Nickajack and Saltpetre caves by Howell and Holt.—Charles E. Mohr, *Reading Public Museum and Art Gallery, Reading, Pa.*

THE ROOSTING-PLACE OF PIPISTRELLUS HESPERUS

In the literature available to the writer, there are no records of specimens of *Pipistrellus hesperus hesperus* (H. Allen) being taken alive from their roosting place. Stephens, (California Mammals, 1906, p. 270), advanced the theory that "they probably hide in crevices in rocks on hillsides during the daytime." Grinnell and Swarth, (Univ. Calif. Publ. Zool. vol. 10, 1913, p. 382), found this species emerging from the crevices of rocks at early dusk.

The only actual records, known to the writer, of *Pipistrellus h. hesperus* being taken alive from their roosting-place are the following three specimens collected by Mr. George Willett of the Los Angeles Museum staff.

Adult male, no. 1133, Los Angeles Museum collection, taken on March 31, 1929, at Fish Traps, (near Indio), Riverside County, California.

Adult male, no. 1527, Los Angeles Museum collection, taken on March 7, 1930, at Parker, Arizona.

Adult male, no. 1540, Los Angeles Museum collection, taken on March 23, 1930, at Palm Canyon, Borego Valley, San Diego County, California.

All three of the above specimens were found by Mr. Willett underneath loose rocks which he had been turning over in search of specimens of land snails. An additional specimen was found under a rock at Palm Canyon, but flew off before he could capture it. The only other species of bat, known to the writer, that roosts beneath loose rocks is *Pizonyx vivesi* of Isla Cardonal, Lower California, Mexico.—Jack C. von Bloeker, Jr., *Los Angeles Museum, Exposition Park, Los Angeles, California.*

SUMMER RECORDS OF EUMOPS CALIFORNICUS (MERRIAM)

Frank Stephens, (Calif. Mammals, 1906, p. 275), states that all dates for the capture of *Eumops californicus* known to him are in winter. Mrs. H. W. Grinnell, (Univ. Calif. Publ. Zool., vol. 17, no. 12, pp. 370–375), records no specimens of this species taken nearer summer than May. Therefore, the following three summer-taken specimens may be worthy of record.

Adult male, no. 24, Los Angeles City Schools collection, taken on June 26, 1918, at Alhambra, Los Angeles County, California, by Luther E. Wyman.

Adult male, no. 420, Los Angeles Museum collection, taken on July 23, 1918, at Alhambra, Los Angeles Co., California, by Luther E. Wyman.

Adult male, no. 812, Collection of Jack C. Von Bloeker, Jr., taken on July 22, 1929, at Gardena, Los Angeles Co., California, by Kenneth E. Stager. This specimen was found by Mr. Stager hanging in a black acacia tree beside a paved street where automobiles were frequently passing.—JACK C. VON BLOEKER, JR., *Los Angeles Museum, Exposition Park, Los Angeles, California.*

DIPHYLLOBOTHRIUM LATUM IN BEAR

On August 26, 1931, a female black bear, *Euarctos americanus americanus*, was autopsied by the writer at the Lake Ranger Station in Yellowstone Park, and found to contain in its intestines about one hundred Russian broad tape worms, *Diphyllobothrium latum*, varying in length from 46 to 84 centimeters.

This bear had been fasted for nearly 48 hours and one incomplete and two complete occlusions of the intestinal lumen and two invaginations of the intestine had taken place. The animal was in poor physical condition for this time of the year. It was killed because of the damage it was doing to automobiles and by biting people.

To determine the degree of infection amongst the bears of this region and the practicability of treatment five bears were caught in a live trap at different times and treated as follows:

No. 1.—Large black male in good physical condition, very vicious. Fasted a total of five days. This bear refused to take any of the medicines offered him except on the fourth day, when he took a honey coated capsule containing seven minims *oleum tiglii* and passed one large round worm, *Tozascaris transfuga*. Kamala in tallow coated capsules rolled in meat, aspidium with honey and oats, capsules coated with cocoa butter, honey, and powdered sugar, were offered.

A subsequent fecal examination did not show the presence of the ova of *D. latum*.

No. 2—Small black male in poor physical condition. Fasted about twenty-four hours and given seventy grams of kamala mixed with cocoa butter, honey, and powdered sugar. Passed about one pint of *D. latum*.

As No. 2 readily took the kamala mixed with cocoa butter, honey, and powdered sugar, the following prescription was worked out:

℞ Kamalae	25 grams
Cocoa butter, melted	25 grams
Powdered sugar	10 grams
M—Ft. duce honey et pwd. sugar ā ā	40 grams

Sig. Give at one dose to small black bear after fast of twelve to twenty-four hours.

These doses can be made up in the laboratory and are convenient to carry in the field.

No. 3.—Medium sized black in fairly good physical condition. Gave above prescription after fast of twenty-one hours thirty minutes. Passed about one-half pint of *D. latum* in three hours, additional one-fourth pint in four hours fifteen minutes and a final passage of four tapeworms after a total elapsed time from the administration of the drug of six hours twenty-five minutes.

No. 4.—Cub, about six months old. Gave five grams kamala in cocoa butter and honey coated capsules after an eight hour fast. Passed two *D. latum*.

No. 5.—Very large black male in excellent physical condition. Gave it above prescription after a fast of twenty-two hours. No tapeworms passed. Subsequent fecal examination failed to show the presence of the ova of *D. latum*.

The foregoing experiments indicate that the parasite, *D. latum*, can be readily eliminated from individual bears with kamala; and that the bears not in good physical condition late in the summer were infected; and that some bears, such as No. 1, have such a disposition that they will not take any suspicious looking or smelling food while in confinement, even after a prolonged fast. No doubt the bears with heavy infestations of tapeworms are constantly in a state of ravenous hunger.

Five bears (three grizzlies and two black) were treated for the broad tapeworm in October with kamala 25 grams, and honey 50 grams, mixed in an ordinary saucepan. Three of these bears were trapped at Beaver Lake, one at Mammoth and one at Madison, all points 20 miles or more distant from Yellowstone Lake. None of these five was found to be infected.

The absence of the Russian broad tapeworm in the bears trapped in October at a distance of more than 20 miles from the Lake may indicate one of two conditions, viz: the infestation in the Park may not extend beyond the Lake district, or, the bear may have a natural means of ridding themselves of parasites before going into hibernation. There is some evidence that most parasites are very specific in their diet and it seems reasonable that the broad tapeworm could not subsist in the intestines of a bear after it goes on a grass diet, which it does in the fall months. If such is not the case a high mortality would result during hibernation, judging from the condition of the bear autopsied on August 26.

According to Stitt,[1] Pratt,[2] Underhill,[3] and Hutyra and Marek[4] dogs, cats, and man become infected with *D. latum* by eating raw or improperly cooked fish which contain the plerocercoid larvae of *D. latum* encysted in its muscles. The specimens were identified by the Zoological Division of the U. S. Bureau of Animal Industry.—W. M. Rush, *Yellowstone National Park, Wyo.*

---

[1] Stitt, E. R. 1923. Practical Bacteriology, Blood Work and Animal Parasitology. Blakiston's Son & Co. Philadelphia.

[2] Pratt, H. S. 1925. A Manual of the Common Invertebrate Animals. McClurg, Chicago.

[3] Underhill, B. M. 1929. Parasites and Parasitosis of Domestic Animals. The MacMillan Co. New York.

[4] Hutrya, Franz and Josef Marek. 1926. Special Pathology and Therapeutics of Domestic Animals. Eger, Chicago.

KAMCHATKA SABLE NEARING EXTINCTION

The hetman Yermak with his fierce band of wild Cossacks having been outlawed and driven across the Urals by order of Ivan the Terrible sought to redeem himself in the eyes of his Czar. This he accomplished by starting the conquest of Siberia by suddenly and without warning capturing the city of Sibir, the last stronghold of the West Siberian Tartars. By levying a tribute of 4,000 sable skins and many other costly furs and presenting them to his former severe master he secured not only his pardon but the post of Governor of West Siberia. On account of the abundance of sables and the extremely high prices paid in Europe, the conquest of the whole vast country was rapidly accomplished. Roving bands of Cossacks spread east and north, penetrating the great primeval wildernesses to the Pacific and Arctic Oceans and conquering and enslaving nearly every native tribe that they came in contact with. Such heavy tribute of sable skins was levied that these animals were soon reduced in numbers, and so greedy were the conquerors that they demanded more and more until the sable became a very rare animal even in the virgin wilderness.

When Atlasof and his small band of about 50 cut-throat Cossacks started the conquest of Kamchatka in the early part of the 17th century, they were presented with a vast pile of sable and sea otter skins by the king of the Kamtchadals, who begged them to depart in peace. Like the rich treasures presented by Montezuma to Cortez this only served to sharpen their greedy lust for more loot and tribute, so they merely waited for reinforcements, when they launched a savage war of extermination against these paleolithic men. In a few years the estimated population of about 60,000 inhabitants was reduced to about 6,000. At that time sables were extremely common. Conditions of life, together with unlimited and wide range in variety of food, are ideal for this animal in Kamchatka. Relentless persecution has reduced the sable to such a scarcity that it is rapidly nearing extinction.

Efforts have been made to domesticate and propagate sables in Kamchatka and in Russia but these trials have met with nearly complete failure. In former times Kamtchadal hunters used to raise young sables to maturity but breeding efforts have nearly always failed, it being the habit of the mother to kill her young when reared in captivity. I visited Kamchatka in 1925 and 1928 and both times spent considerable time with Rene Malaise, a scientist of the Swedish Kamchatka expedition. At Klutcki on the Kamchatka River he first attempted to raise sables for the Soviet government in 1925–1926 but they ran away. Again in 1928, while I was engaged in collecting plants in the Avatcha River district, Malaise had built a large and spacious fur farm for sables amongst the best kind of natural surroundings and habitat. He made a special study of sables and fur farming but all to no avail. With great efforts three sables were secured in three years, one of which subsequently died and the others finally escaped. Malaise was put under arrest in 1930 and then sent out of the country because of the failure. The attempt has practically been given up on account of scarcity of sables. When I visited the zoo in Moscow with Mr. R. McKean Grant last November, the keeper showed us his sables. He had the woman caretaker show us how tame and playful her pets could be. It was amusing to watch them at their antics especially when crawling up sleeves and into pockets. The keeper told us that these were mostly raised from two litters born in captivity from the old female and that these are the first authentic records of breeding sables successfully in captivity.

Because of certain short-minded policies emanating from the central government in Moscow, the sable is in more danger than ever. In order to push through with the five year plan which is intended to put the Soviets on a firmer industrial foundation, the government is using desperate methods to convert every salable object into ready cash. Everything is to be sacrificed if necessary to insure brighter hopes for the future.

Although the Kamchatka local government has solemnly put a strict ban on the hunting and sale of sable skins for three years in succession (1928, 1929, and 1930) still each time special orders from Moscow overruled and canceled this law in favor of open season. The government pays 20 roubles per skin, which is an arbitrary fixed price. Nobody else is allowed to purchase them. Although the government forces everyone to accept 1.95 roubles per American dollar the actual purchasing value of a rouble is about 10 cents. Out of U. S. S. R. roubles can be purchased from money exchanges for 20 to 40 roubles for 1 dollar. Japanese fishermen reap great advantage from this situation when opportunity affords to turn poacher. They pay upwards of 300 roubles per skin to native trappers, very few of whom will even allow it be known to the government that they are trapping. The Japanese won fishing rights in the Russo-Japanese war and thereby are allowed within the three mile limit. Most of Kamchatka is a vast wilderness of forests, tundras, and great volcanoes with hardly a village in the entire portion south of Avatcha Bay. Hunters and trappers spend the winter tracking sables and traveling over wide stretches by dog teams. The winters are long and the snow lasts well into May. A secret rendezvous has been arranged the year before by one of the more energetic and enlightened hunters with a Japanese fisher boat on the sea of Okhotsk side of the peninsula, where he will dispose of his catch of furs at ten or fifteen times the price he would get from the government. When he returns to his village he will be met by the secret police. He will have one or two skins to sell and it will be impossible to find out whether the season has been a failure or a success. Of course the catch at best will be comparatively very small. The conclusions drawn from the above I have from observation and personal contact with native sable hunters.

Illicit fur buying on the part of Japanese poachers is probably a greater menace to the sables than the lack of a closed season.—Walter J. Eyerdam, *9253 Corliss Ave., Seattle, Washington.*

OCCURRENCE OF THE LEAST WEASEL IN MICHIGAN

A specimen of the least weasel, *Mustela rixosa allegheniensis* (Rhoads), was killed by a cat near Rochester, Oakland County, Michigan, October 20, 1931. There seems to be no previous record of the occurrence of this weasel in the State of Michigan.

The skin and skull of this specimen are preserved in the collection of the School of Forestry and Conservation, University of Michigan.—Ned Dearborn, *Ann Arbor, Michigan.*

THE FRANKLIN SPERMOPHILE IN ONTARIO

In "The Mammals of Ontario" by E. C. Cross and J. R. Dymond, published in 1929, there is no mention of the Franklin Spermophile. So I record one seen by me, in May, 1929, at Rainy River Station, on the Canadian National Railway, near Lake of the Woods, western Ontario.

This locality is now deforested and is doubtless attractive to campestrine rodents. The narrow Rainy River separates it from Lake of the Woods County, northwestern Minnesota.—Morris M. Green, *Ardmore, Pennsylvania.*

WINTER ACTIVITIES OF THE EASTERN CHIPMUNK

On February 1, 1932, D. R. Burtsfield, R. E. Jordan, and the writer were visiting Turkey Run State Park, which lies in the west-central part of Indiana. At 10 o'clock in the morning two chipmunks, *Tamias striatus*, were seen, one chasing the other about the trees and stumps of the hotel grounds, and on returning at noon another, or more likely one of the two seen before, was noticed dodging into a hole between the buttressed roots of a large beech at the same place. The day was cold and wet, and the chipmunks seemed quite out of place under the circumstances.

The preceding part of the winter had been very mild, as it was in most of the mid-west, and the week or two before had been especially spring-like in temperature. In addition, a large crop of nuts had set on the many beeches about the park. Chipmunks are very common in that locality in the summer, and probably this was just one of many similar cases, although no others were noted during the day.—Frederick H. Test, *West Lafayette, Indiana.*

A SOMEWHAT UNUSUAL KITCHEN MIDDEN OF FREMONT'S SQUIRREL (SCIURUS FREMONTI FREMONTI)

One often finds in the Colorado mountain forests considerable deposits of the debris left by Fremont's squirrels from feeding on the cones of various conifers, but the one I am about to describe was very different from any that I had previously seen.

On August 19, 1931, I had been examining and photographing a beaver pond near Brush Creek, Gunnison County, at about 9,000 feet altitude, and on the slope of a low ridge above one end of the pond I found this deposit. It was 33 feet long, nowhere, I think, less than 3 feet wide, and in places four feet or more. It lay diagonally along the hillside with a slight downward slope. At the upper end it was four feet wide at the surface, and here I dug down into it a foot and apparently did not reach bottom. The lower part was somewhat decayed and much compacted. At another place, likewise, it was over a foot deep.

Twenty-four feet from the upper end was a cache of green Engelmann spruce and balsam fir (*Abies lasiocarpa*) cones, 16 of the former, 4 of the latter.

Eighteen feet of the upper end of the stuff lay on top of and along each side of an old rotten log. Many holes were dug into this by the squirrel, and some contained a few cones, both of spruce and fir, with an occasional lodgepole pine cone. Some cones were also scattered here and there on top of the deposit. Another cache contained 24 spruce cones, beside some fir. Altogether I found five caches.

Close by was a small spruce, and in this, ten feet from the ground, was an abandoned summer nest, part of which had fallen to the ground. It was a mass of dry grass, and may have been 15–18 inches in diameter.

The forest here was an open one of Engelmann spruce and balsam fir, with a few lodgepole pines. The latter species formed the forest all about the beaver pond except at this place.—Edward R. Warren, *Colorado Springs, Colo.*

UNUSUAL ABUNDANCE OF POCKET MICE AT SAN FELIPE NARROWS, CALIFORNIA

During March, 1932, Mr. Frank Stephens and the writer spent three days at San Felipe Narrows, San Diego County, California, collecting mammals for the San Diego Society of Natural History and the writer's collection, respectively. Each night I set 175 traps over an area of about one-half mile. Pocket mice, genus *Perognathus*, fairly swarmed over the place. The first morning, March 21, I found more than 120 specimens of *Perognathus*, representing five distinct groups, in my traps and no other genus of mammals represented. During the daytime of March 21, a few traps ,which had been untouched during the previous night, caught the following specimens of pocket mice: *Perognathus longimembris arenicola*, 1; *P. spinatus rufescens*, 2; and *P. b. baileyi*, 3. These specimens were not discovered until about 4 P.M. and, consequently, were spoiled by the hot desert sun.

Dipodomys merriami and *Peromyscus eremicus*, usually abundant in the type of country around San Felipe Narrows, were very little in evidence. During our stay at this locality, we trapped only five *Dipodomys merriami* and six *Peromyscus eremicus*. Three *Peromyscus crinitus stephensi* also were trapped, but, in addition to these 14 examples, no other mammals were secured besides pocket mice. With conditions as favorable as this for collecting pocket mice, it was easy to secure a good series of each species. One hundred and twenty-nine specimens were preserved, by the writer, as follows: *Perognathus longimembris arenicola*, 31; *P. formosus mesembrinus*, 17; *P. penicillatus angustirostris*, 40; *P. baileyi baileyi*, 15; *P. spinatus rufescens*, 19; *Dipodomys merriami simiolus*, 3; *Peromyscus crinitus stephensi*, 2; and *Peromyscus eremicus eremicus*, 2.

On two previous occasions I have been fortunate enough to find pocket mice of two species, which were formerly regarded as rare, in great abundance (Journ. Mamm., vol. 9, no. 2, p. 152, May, 1928, and vol. 12, no. 4, pp. 369–372 and pp. 431–432, November, 1931). The fluctuations in numbers of pocket mice is a subject about which very little is known and any information relative thereto would be of real value to mammalogists working in this field.—Jack C. von Bloeker, Jr., *Los Angeles Museum, Exposition Park, Los Angeles, California.*

NEW LOCALITY RECORDS FOR PEROGNATHUS BAILEYI FROM CALIFORNIA

Perognathus baileyi baileyi (Merriam), was first taken in California at Mountain Spring, San Diego County, by Frank Stephens on March 24, 1909. Two specimens were collected and are now in the Museum of Vertebrate Zoology, Berkeley, California. Mr. Stephens (in correspondence, April, 1932) says he recently found, among his notes, the record of two additional specimens of *P. b. baileyi* taken at Banner, San Diego County, California, on November 24, 1912, collected by himself. Several years ago Laurence M. Huey collected specimens of *P. b. baileyi* at Bard, Imperial County, California (not previously recorded).

Recently I spent three days (March 21 to 23, 1932) at San Felipe Narrows, San Diego Co., California, and secured, among other specimens, fifteen *Perognathus baileyi baileyi*. It was with some surprise, a few days later, on the morning of March 26, that I discovered two specimens of *P. b. baileyi* in my traps at La Puerta Valley, San Diego Co. Previously this locality has produced representatives of the following species: *Perognathus spinatus*, *P. fallax*, *P. californicus*, *P. penicillatus*, *P. formosus*, and *P. longimembris*. With the addition of *P. baileyi*

to this list, it is shown that La Puerta Valley is host to seven species of *Perognathus;* more, I believe, than are found at any other single locality.

The only food found in the cheek pockets of the seventeen specimens of *baileyi*, taken by the writer, other than trap bait, were the green leaves of "filaree," (*Erodium sp.*). Seven of the seventeen specimens collected were adult, the remainder immature.

Average measurements of six adult specimens of *Perognathus baileyi baileyi* are as follows: Total length, 227.3 mm.; tail, 119.6 mm.; hind foot, 27.8 mm.; ear (from crown), 9.1 mm. The only adult male taken measures: T.l., 218; T., 113; H.f., 28; Ear, 9. Largest female measures: T.l., 238; T., 126; H.f., 27; Ear, 9.

I wish to express my thanks to Mr. Frank Stephens for the use of his records herein reported. Mr. Stephens accompanied me during my three-day stay at San Felipe Narrows and, while there, obtained five adult specimens of *P. b. baileyi*.—Jack C. von Bloeker, Jr. *Los Angeles Museum, Exposition Park, Los Angeles, California.*

NOTE ON "COSOMYS" WILSON, FROM THE PLIOCENE OF CALIFORNIA

In the last number of the Journal of Mammalogy (p. 150) R. W. Wilson has given a very clear and beautifully illustrated account of an interesting vole from the Pliocene of California which he describes as a new genus and species, *Cosomys primus*. Mr. Wilson himself points out the close affinity the Californian fossil possesses with the European fossil genus *Mimomys* and the living Old World genus *Arvicola*; and since a study of his paper fails to reveal a single character which would suffice to separate the fossil from *Mimomys* generically, I think *"Cosomys"* must be regarded as a synonym of *Mimomys*. If this view be adopted the interest of the Californian fossil is greatly enhanced since it shows us that *Mimomys*, like the living *Clethrionomys*, *Pitymys*, and *Microtus* and some other Microtine genera, is a genus of circumpolar distribution. From another point of view there really is not room for a genus intermediate in character between *Mimomys* and *Arvicola*; for here in England, tracing *Mimomys* forwards from the Pliocene, and *Arvicola* backwards from the present into our earlier Pleistocene horizons, we reach a point where it becomes impossible to determine which genus we are dealing with, although the material from the horizons in question is abundant, if fragmentary.

Two points in Mr. Wilson's account call for a little notice. He states that "the temporal ridges in the interorbital region are . . . feebly fused in *Cosomys*." That is an interesting but not surprising fact. This part of the skull is known in Europe, so far as I recollect, only from one specimen, a detached frontlet in the Savin Collection from the Upper Freshwater Bed at West Runton, which I provisionally referred to *M. intermedius*, the chief and most common species occurring in that deposit. That specimen was the sole foundation for my statement: "Temporal ridges in some species, at all events, widely separated in the interorbital region."[1] But in all likelihood certain species of *Mimomys* make a nearer approach to *Arvicola* in this respect than do other species; for the only character absolutely separating the two genera is the persistent or non-persistent growth of the cheek-teeth.

The other point is of much greater interest. Mr. Wilson states, and his figures

[1] Hinton, Monograph of Voles and Lemmings, vol. 1, p. 356, 1926.

bear out the statement, that the molars of the Californian fossil are very like those of *Mimomys pliocaenicus*. Personally I should (as a palaeontologist) refer the mandible, despite its American origin, to that species, just as I would a fossil jaw of *Clethrionomys gapperi* to *C. glareolus*. But the character of the m^3 shows that the Californian species is a little more primitive in being posteriorly less reduced than in *M. pliocaenicus*. In my monograph (pp. 362 & 363) I have pointed out that this latter species had gone a little too far in this one respect to be regarded as directly ancestral to the more highly specialized forms which accompany it in some of the later deposits in which it occurs and, in still newer horizons, supersede it altogether. On the other hand *M. primus* is, as regards tooth pattern, completely satisfactory as an ancestor for our later species.

The roots of the cheek-teeth, particularly those of the upper jaw, are of great interest in *Mimomys* and it is to be hoped that Mr. Wilson will publish details concerning them in the Californian fossil.

In conclusion I would say that I have long felt pretty certain that remains of *Mimomys* will be recovered sooner or later from the Pliocene and early Pleistocene deposits of Asia. That the Asiatic genus *Phaiomys* is, like *Arvicola*, a descendant of *Mimomys* I have no doubt at all. (Monograph, pp. 48–50.)—MARTIN A. C. HINTON, *British Museum (Natural History), London, England.*

A SHIPMENT OF MUSKRATS TO KAMCHATKA

In May, 1928, amongst other duties as a member of the Wilson Fisheries Diesel motor ship *Apex* I was assigned the task of caring for 40 muskrats destined to Karaginski Island on the northeast coast of Kamchatka. This ship as well as the Diesel motor schooner Charles Brower had just been purchased by the Soviet government. Another ship that had been delivered at Vladivostok two months before had also taken a consignment of 40 muskrats but only one diseased individual survived. This was evidently on account of neglect and ignorance of proper care.

Three days before sailing time the rats arrived by express from the province of Ontario. These are a hardy breed capable of standing a rigorous climate and have an excellent quality of pelage when prime. On account of the long train trip and sudden change of living conditions some of the animals were in a rather dejected state. Two of them were dead upon arrival and several others were quite sick; two of these died three days later. One was skinned, dissected, and examined for diseases. The feet and tail were scabby and the intestines and kidneys and liver were spotted and of livid color due to inflammations.

The original shipment consisted of an equal number of each sex, and each rat had a separate compartment 10 x 12 x 18 inches, with sheet metal sides, bottom and roof of galvanized mesh wire ½ x ½ inch. One of the males, which was a particularly vicious animal, dashed at me one morning, as was his custom, and fell overboard. This happened not far from Bella Bella, B. C. Of course he probably reached the shore without difficulty.

The males were always vicious and intractable, some exceptionally so. Invariably these more villainous reprobates would fight recklessly as soon as the door was opened. I had a special kind of an iron hoe, made to keep them in the back of the pen while it was being cleaned. During this process the most intractable old bucks would savagely attack the hoe. Thinking that one of these fellows

was sick one day I locked him in a stateroom. When I came to attend to him the next morning he not only was quite well again, but so resented my presence that he attacked me viciously and jumped nearly two feet high at my hand. With his chisel-like teeth he gashed my left hand middle finger to the bone. Although quite cautious I received a couple of minor gashes later. The crates had been labeled by the shippers "Caution—Vicious Animals." The females were docile and never once tried to attack me. They never seemed to resent my presence and some of them would take a carrot from my hand. The males were so ugly-tempered that I doubt if they could ever be properly tamed.

The drinking cans had to be cleaned out at least once per day, because, after drinking the clean water the rats frequently used them as urinals or as defecating receptacles. If not enough hay was given as bedding and to cover the excrement, the latter was generally found plastered like mud the next morning in the wire mesh overhead. Vegetables had to be washed before feeding, but these were not always clean enough for some of the more fastidious animals who rewashed them in their cans.

By keeping up a rigorous routine of thoroughly cleaning out the pens each morning and giving new alfalfa bedding, and by feeding the animals twice a day with grain, a small piece each of carrot and apple with an occasional piece of turnip or celery, and supplying fresh clean water, I succeeded in making the sick rats recover and all the rest improve in health and vigor. Upon arrival at Petropavlovsk, 32 days after leaving Seattle, 35 rats were turned over in perfect condition to the Russian keeper who was instructed in their proper care.

Before arrival at Petropavlovsk the partitions of the pens were taken out, thus making each one twice as roomy. The sexes were then put together, two animals in each double compartment. In the daytime as a rule there was little courting done, but during the first week at night time there was much squealing, stamping, gnawing of wire mesh, and amorous activities. A few couples of more highly strung tempers were not overly amiable toward each other, but most of them seemed quite content to be together.—WALTER J. EYERDAM, *9253 Corliss Ave., Seattle, Washington.*

A "HORNED" BLACKTAIL DOE WITH FAWN

Early in June, 1931, while on the McDonnel Brothers' Ranch in Knights Valley, Sonoma County, California, I had the opportunity of witnessing the interesting phenomenon of a "horned" doe suckling a fawn.

That section of the country, lying approximately twelve miles north of Calistoga, and along the western slopes of Mt. St. Helena, consists mainly of range and pasture land, and is primarily devoted to cattle grazing. The hills vary from gently rolling to steep, with a few sharp canyons. The vegetation is mostly chaparral and oaks with some California laurel and Douglas fir.

The deer in that region are *Odocoileus columbianus*, the common blacktail of the Pacific Coast, and are quite numerous. The does outnumber the bucks very markedly, possibly in the ratio of 15 or 20 to 1. Accurate figures are very hard to secure because the females are seen more commonly than the males, which, except for a few months of the year, remain in the tall brush. Probably the large ratio of does to bucks results from the long continued adherence to the "buck law" in California.

This antlered doe was either a yearling or a short two-year-old, for she was much smaller throughout than the usual mature doe seen in that region. She appeared to be normal in every other respect save that her head supported a peculiar growth of antlers. They were not like the growing antlers of a buck, but appeared to branch at once into several spikelets, each of about the diameter and nearly the length of a lead pencil. The place of branching was at or close to the base of the antler.

I was unable to get near enough to her to be sure that she did not show any other masculine characteristics about the head and face. Her body was entirely that of a doe; it was fine, light and trim, and lacked the rugged and somewhat heavier characteristics common to the males of this species.

The fawn was still in the spotted coat, apparently healthy and normal, and had reached the stage of development to be seen in the other fawns of the year in that vicinity.

The appearance of an antlered doe in that part of Sonoma County is not altogether unknown. Mr. McDonnell and his father before him have occupied that particular ranch since 1850. The immediate region has always been populated by large numbers of deer and these men have seen perhaps thousands of them. In the span of 80 years they have noted about 12 or 14 "horned" does. Mr. McDonnell is of the opinion, however, that most of the antlered does observed carried forked antlers and otherwise exhibited the secondary sexual characteristics of the male. —LESTER J. BERRY, *College of Agriculture, University of California, Davis, Calif.*

FOURTEENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The fourteenth annual meeting of the American Society of Mammalogists was held at the United States National Museum from May 3 to May 7, 1932. There were 120 members present, representing 14 states and one Canadian province. This was the largest gathering in the history of the Society.

PROGRAM

TUESDAY, MAY 3

8.00 *p.m.*

Meeting of the Board of Directors at the Hotel Washington

WEDNESDAY, MAY 4

9.30 *a.m.*

Address of welcome. C. G. Abbot, Secretary, Smithsonian Institution.

1. Geographic and ecologic distribution of mammals in Leelanau County, Michigan. Robert T. Hatt.
   Discussed by L. R. Dice, M. W. Lyon, Jr.
2. The badger, *Taxidea taxus* (Schreber), in Indiana. M. W. Lyon, Jr.
   Discussed by T. S. Palmer, C. C. Sperry, V. Bailey.

3. The status of *Peromyscus leucopus ammodytes*. Philip F. Allan.
   Discussed by M. W. Lyon, Jr.
4. Fertility relationships of subspecies and species of *Peromyscus*. Lee R. Dice.
   Discussed by H. H. T. Jackson, E. R. Hall, T. S. Palmer.
5. Classification of the North American Sciuridae. Arthur H. Howell.
   Discussed by T. S. Palmer, M. W. Lyon, Jr., E. R. Hall.
6. A serious twelve-month malocclusion case in a rabbit, with the animal in good physical condition. Albert R. Shadle.
   Discussed by V. Bailey.
7. Distribution of South American shrews. G. H. H. Tate.
   Discussed by H. H. T. Jackson, H. E. Anthony, E. R. Dunn.
8. Collecting in British Guiana. W. M. Mann.

2.15 *p.m.*

9. Notes on a recent visit to museums around the world, with special reference to Peiping and Moscow. Harold J. Coolidge.
   Discussed by T. S. Palmer, F. Harper, M. W. Lyon, Jr.
10. A revision of the lemurs. Richard Archbold.
    Discussed by R. Kellogg, C. W. Stiles, E. Huber, E. A. Goldman, H. H. T. Jackson.
11. A Miocene mammalian fauna from Southeastern Oregon. C. Lewis Gazin.
12. Status of International Convention for Protection of Whales. Lewis Radcliffe.
    Discussed by A. R. Shadle, R. Kellogg, H. J. Coolidge, W. E. Saunders.
13. Age variations in the teeth and skull of whitetail deer. Victor H. Cahalane.
    Discussed by H. J. Coolidge, E. A. Goldman.
14. Geographic variation in the puma. E. A. Goldman.
    Discussed by G. H. H. Tate, J. K. Doutt, A. R. Shadle, H. J. Coolidge.
15. Twenty-seven months in the Arctic. J. S. Warmbath.

8.00 *p.m.*

16. Travels in South West Africa. Rodolphe M. de Schauensee.

Following this lecture, a smoker and conversazione was held in the National Museum foyer.

THURSDAY, MAY 5

9.30 *a.m.*

17. Segmental changes in the mammalian trunk, with special reference to the Primates. William L. Straus, Jr.
    Discussed by R. T. Hatt, G. H. H. Tate.
18. The morphology of the shoulder and hip architecture in Tetrapods. A. Brazier Howell.
    Discussed by R. T. Hatt.
19. Color of certain desert rodents in relation to the color of the rocks where they live. Philip M. Blossom and Lee R. Dice.
    Discussed by H. H. T. Jackson, E. R. Hall, E. A. Goldman.

20. A remarkably colored pocket-gopher from Costa Rica. E. A. Goldman.
Discussed by H. J. Coolidge.
21. Results of a sytematic study of American weasels as applied to ancestry theories of species forming. E. Raymond Hall.
Discussed by T. S. Palmer, H. Friedmann, E. A. Goldman.
22. The body proportions of adult catarrhine Primates. Adolph H. Schultz.
Discussed by H. J. Coolidge.
23. Ascheim-Zondek test for pregnancy. M. W. Lyon, Jr.
Discussed by A. R. Shadle, F. R. Hagner, E. Huber, C. Hartman.
24. Activities of the American Committee for International Wild Life Protection during the past year. Harold J. Coolidge.
25. The brown bear in Alaska. John M. Holzworth.

2.15 *p.m.*

26. The Edwin S. George Reserve of the University of Michigan—a preview. Paul Hickie.
27. Some field methods of an amateur shrew collector. Morris M. Green.
Discussed by V. Bailey, H. H. T. Jackson.
28. How the porcupine moves its quills. Curt P. Richter and Orthello R. Langworthy.

3.00 *p.m.*

Annual Business Meeting of the Society

7.00 *p.m.*

The annual dinner of the Society was held in the Hotel Washington. Following the dinner there was an illustrated talk on "Presidents I have known" by Clifford K. Berryman, and Mr. and Mrs. Martin Johnson showed five reels of their pictures recently made in East Africa and the gorilla country.

FRIDAY, MAY 6

9.30 *a.m.*

29. The proposed new hall of North American mammals at the American Museum of Natural History. H. E. Anthony.
Discussed by E. A. Goldman, M. W. Lyon, Jr.
30. A mother black bear in hibernation. Leo A. Luttringer, Jr.
Discussed by J. M. Holzworth, H. C. Bryant, J. K. Doutt, W. E. Saunders, W. Huber, A. R. Shadle.
31. The moose on Isle Royale. Adolph Murie.
Discussed by V. Bailey, L. R. Dice, E. A. Goldman, J. S. Warmbath, H. S. Bryant.
32. The value of coöperation in biological studies illustrated by concrete examples. Carl G. Hartman.
Discussed by A. R. Shadle, M. W. Lyon, Jr.

33. Trapping animals alive. Vernon Bailey.
    Discussed by E. P. Walker, W. E. Sanderson, Mrs. C. N. Edge, A. R. Shadle.
34. Collecting bats in the Philippine Islands. Paul Bartsch.
35. Studies on the vertebral column of leaping rodents. Robert T. Hatt.
    Discussed by E. A. Goldman, L. R. Dice, E. A. Preble.
36. On some recent and extinct mammals of Patagonia. George Gaylord Simpson.

2.15 *p.m.*

37. Authenticity in motion pictures of wild animals. A Symposium led by Martin Johnson.
    Discussed by H. J. Coolidge, W. K. Gregory, J. S. Warmbath, W. B. Bell, E. A. Goldman.
38. Remarks on the Collins-Garner collection of mammals from Gabon, French Equatorial Africa. H. Harold Shamel.
39. Geologic and geographic history of the Archæoceti. Remington Kellogg.
    Discussed by W. K. Gregory, A. R. Shadle.
40. Preliminary report on investigations of coyote food habits. Charles C. Sperry.
    Discussed by L. R. Dice, E. A. Goldman, F. Harper, E. R. Hall, H. H. T. Jackson.

4.15 *p.m.*

Final Business Session of the Society

SATURDAY, MAY 7

The members gathered at the Lion House in the National Zoological Park and were conducted on a tour of the park by the director, William M. Mann. Following this the members assembled for a picnic luncheon on the lawn, as guests of Doctor Mann and the Washington members.

At the meeting of the Directors on May 3, Hartley H. T. Jackson was appointed Recording Secretary *pro tem* for all sessions in the absence of H. H. Lane. W. K. Gregory was elected a trustee to succeed Childs Frick. Francis Harper, Corresponding Secretary for the past year, presented his resignation and by unanimous vote was thanked for his efficient services. The present Editorial Board was reappointed and appreciation was expressed for their fruitful labors of the past year.

At the annual business meeting the election of officers resulted as follows: president, M. W. Lyon, Jr.; vice-presidents, H. E. Anthony, T. S. Palmer; corresponding secretary, R. T. Hatt; recording secretary, H. H. Lane; treasurer, Mrs. Viola S. Snyder. Directors for 1932–34 were elected as follows: W. K. Gregory, R. M. Anderson, C. C. Adams, L. R. Dice, and H. H. T. Jackson.

The following summary of membership and subscription conditions was presented:

New members elected at the current meeting	71
New subscribers added since last meeting	13
Total gross additions to mailing list of Journal	84

Resignations since last meeting	64
Deaths reported since last meeting	6
Number of members delinquent, 1932 dues	118
Number of members delinquent, 1931 dues	36
Number of honorary members	4
Number of life members	56
Number of annual members	871
Total present membership of the Society	931
Number of subscribers	151
Present mailing list of the Journal	921

The six members lost by death were: Charles Livingston Bull, Henry R. Carey, Donald R. Dickey, James W. Gidley, George T. McNair and William Nesbit.

Reports of the various committees were read and it was voted to publish that of the committee on Life Histories and Ecology.

The regular order of business was temporarily suspended in order to allow a non-member, R. Y. Stuart, Chief of the U. S. Forest Service, to discuss a resolution concerning the protection of the large bears of Alaska, and on making Admiralty Island a sanctuary for those animals. Following extended discussion, in which opposing views were presented, the following resolution was passed:

RESOLUTION RECOMMENDING ADMIRALTY ISLAND AS A BEAR SANCTUARY

WHEREAS, the American Society of Mammalogists reaffirms the position taken at the annual meeting of 1930, namely, that inadequate protection is now given to the large bears of Alaska and that Admiralty Island is needed as an inviolate sanctuary for these bears, and

WHEREAS, no substantial remedial action has been taken by either Federal or Territorial authorities in the intervening two years, and

WHEREAS, the proposed plan of the Government to exploit Admiralty Island as a source of wood pulp seriously menaces any proposal to use the Island as a wild life sanctuary, and

WHEREAS, it has been demonstrated to the Society through communications of the American Paper and Pulp Association that there now exists no economic justification for the exploitation of the timber on Admiralty Island,

Therefore Be it Resolved, That the American Society of Mammalogists again strongly urges the Alaska Game Commission, the United States Biological Survey and the U. S. Forest Service to provide adequate protection for the large bears of Alaska, and

Be It Further Resolved, That the Society believes that the value of Admiralty Island as an inviolate wild life sanctuary greatly outweighs the doubtful economic returns from the Island as a source of wood pulp and strongly urges that Admiralty Island be made an inviolate wild life sanctuary.

RESOLUTION APPROVING SENATE BILL NO. 263

A resolution was passed approving Senate Bill No. 263, an act to promote the conservation of wild life, fish and game, and for other purposes.

RESOLUTION OPPOSING THE POISONING OF PREDATORY MAMMALS AND RODENTS

The Committee on Predatory Animal Control, H. E. Anthony, Chairman, presented the following resolution, which was adopted by a written ballot of 34 to 26. It was further voted that the result of the ballot be published in the Journal.

WHEREAS: It has come to the attention of the American Society of Mammalogists through various channels, such as "The Condor" and "Science" that Federal and State authorities continue extensively to employ thallium and other poisons which have been demonstrated to be wasteful of many species of wild life, and,

WHEREAS: The constant additions to the list of species selected for drastic control because of alleged damage to certain vested interests arouses the fears of the Society for all forms of wild-life, therefore,

Be it resolved: That the American Society of Mammalogists reiterates its opposition to the present control methods and policies as practiced against predatory mammals and rodents, and again urges the United States Biological Survey to cease the widespread use of poison and the active dissemination of propaganda calculated to create a demand for control.

The Society also expressed by resolution its thanks and appreciation to W. M. Mann, W. C. Henderson, H. H. T. Jackson, Remington Kellogg and E. P. Walker, of the Local Committee for their most excellent work in providing for the comfort and convenience of the members, and for the splendid program and very enjoyable entertainment provided at the meeting.

An invitation extended by the Museum of Comparative Zoology to hold the annual meeting of 1933 at Cambridge was unanimously accepted and the determination of the exact time of the meeting left in the hands of the Local Committee, of which Dr. Thomas Barbour was made chairman.

REPORT OF THE COMMITTEE ON LIFE HISTORIES AND ECOLOGY

The Committee on Life Histories and Ecology has little to offer this year in the way of specific achievements. We have undertaken to distribute Seton's "Lives of Game Animals" at a greatly reduced price to the member of the Society, by arrangement with the publishers. Many members are taking advantage of the opportunity and orders are still coming in.

Your committee has endeavored to keep in touch with progress and events bearing on Ecological considerations and would like to offer a few suggestions.

We are all of us concerned over the problem of preserving our fauna. The sportsmen are making frantic efforts to increase the game supply in the face of the increasing numbers of hunters and the advertising of sport. Scientists and Nature Lovers, although not so well organized, are becoming more active in general conservation. Economic interests, here and there, are objecting to the presence of various forms of animal life. The result of conflicting interests and suspicions is a general turmoil in conservation efforts. The committee believes that what is needed is that all interests unite on a more cooperative basis and try to understand one another's points of view and agree on the ultimate objective of conservation.

Our environment is complex. For numerous reasons many of us wish to preserve wild life to the utmost extent possible. After all, we should give as detailed con-

sideration to our own ecological relationships as to those of burrowing rodents. The best thinkers agree that "Nature," as generally understood, has a wholesome effect on human beings. The efforts of scientists and nature lovers to preserve our natural environment is highly commendable. To achieve the results sought for we must meet the objections of those who do not understand our aims, and we must recognize and understand situations which tend to interfere with legitimate economic activities.

The question is a difficult one. However we believe that with a better understanding of the ecological position of our various animals more progress can be made. We need facts with which to work and must get away from mere tradition. For example, there appears to be a widespread feeling that rodents, in general, are destructive and entirely undesirable. As you know, some species are harmless or of no consequence in their effects on crops. Some of the so-called "destructive" species may be neutral in their economic position in some localities. As a matter of fact, rodents serve as an important food supply for many of our important fur-bearers and raptores. What would become of our "beneficial" hawks and owls if the rodents were eliminated? They would immediately be placed in the "harmful" class and be persecuted. The same applies to fur bearers. In limited areas, which have been "cleaned up" to an extreme degree, ordinarily beneficial species are likely to resort to the farmers' or the game keepers' yards for food.

Our wild fur-bearing animals, the carnivorous forms in particular, have been neglected. Perfunctory protection, or no protection, appears to be the rule in many states, with the exception, perhaps, of only a few species. In many cases valuable fur bearers are denounced as a nuisance.

Much of our confusion would doubtless disappear with a better understanding of the habits of our mammals, particularly of the smaller species. With the wealth of literature and tradition on the habits of animals it may seem unreasonable to state that our information is insufficient. Yet we would respectfully submit that often our knowledge is not detailed enough, and the emphasis is often misplaced.

To mention only one of the more recent studies of small mammals, we would commend the work of Robert A. Greene and Charles Reynard, whose article, "The influence of two burrowing rodents, *Dipodomys spectabilis spectabilis* (Kangaroo rat) and *Neotoma albigula albigula* (Pack rat) on desert soils in Arizona," appeared in Ecology for January, 1932.

We believe that some of the intangible factors in the ecological relationships of animals may be far-reaching and most important in their ultimate effect. Since the layman is inclined to disregard such considerations it is necessary for the scientist to get the facts and present them in convincing form.

This committee appeals to Universities, Museums and other research groups, and particularly to the members of the American Society of Mammalogists, to obtain detailed information, by experiment or otherwise, on the ecology of our smaller mammals.

The Committee has offered its services to those undertaking life-history studies. It is the feeling of the committee that students of mammals should keep it informed of their proposed studies so that the committee can better function as a clearing house for information of value to students in this field.

The Committee submits for your consideration the following resolution:

WHEREAS, the American public, in its desire to preserve our wild life resources

for various purposes, is confronted with serious lack of detailed information on the interrelationships of many species of animals, and

WHEREAS, the wild fur-bearing carnivores, to mention only one group, are relatively neglected in our wild life administration, and their diverse values not well understood, therefore,

Be It Resolved, that the American Society of Mammalogists, in its Annual Meeting assembled at Washington, D. C., May 5, 1932, recognizing the value of the study of the food habits of mammals recently inaugurated by the Bureau of Biological Survey, does hereby urge the said Bureau of Biological Survey to undertake, as a further logical and necessary step in this program, detailed studies of the life histories and the ecological relations of our wild stock of fur-bearing carnivores, with a view toward establishing upon a sound basis the conservation of this national resource.

RECENT LITERATURE

ABEL, O. William Diller Matthew (1871-1930). Palaeobiologica, vol. 4, pp. 1–24, pl. 1931.

ADAMS, S. B., J. F. G. WHEELER AND F. H. EDGEWORTH. On the innervation of the platysma and the mandibulo-auricularis. Journ. Anat. London, vol. 63, pp. 242–252, figs. 3. 1929.

ALFTMAN, HERBERT O. Pleistocene mammals of Fossil Lake, Oregon. Amer. Mus. Nov. no. 481, pp. 1–21. July 14, 1931.

ALLEN, G. M. Mammals. [*In* Vertebrates from the Corn Islands (off Nicaragua).] Bull. Mus. Comp. Zool. Harvard, vol. 69, no. 7, pp. 129–130. April, 1929.

——— Ocean dolphins. Bull. Boston Soc. Nat. Hist., no. 61, pp. 3–7. October 1931.

AMSCHLER, WOLFGANG. Über *Capra aegagrus* und *Capra falconeri* als Hausziegen im Kaukasus, eine Vorarbeit zur genetischen Bearbeitung der Hausziegen. Wiss. Archiv. Landwirtsch. Abt. B. Tierernähr. u. Tierzucht, vol. 3, no. 2, pp. 307–338, figs. 13, 1 map. 1930.

ANDERSEN, K. T. Morphologische und kausalanalytische Untersuchungen über die Entwicklung der Magengegend bei *Sus scrofa domestica*. Zeitschr. Anat. Entw.-Gesch. Berlin, vol. 88, pp. 652–696, figs. 21. 1929.

[ANONYMOUS] Wild game census in Colville National Forest, northeastern Washington. Murrelet, vol. 12, no. 1, p. 26. January, 1931.

——— Pennsylvania Game News: Bounty successfully controls predators in Pennsylvania. Outdoor Life, vol. 67, no. 2 p. 40. February, 1931.

ANTHONY, R. Discussion sur l'interprétation de la série dentaire inférieure du *Stehlinius uintahensis* Matth. Bull. Mus. Hist. Nat. Paris, vol. 34, no. 6, pp. 416–421, figs. 2, 1928.

——— Observations sur les fosses nasales des Équidés. Archiv. Anat. Histol. Embryol. Strasbourg, vol. 10, pp. 235–270, pls. 2, figs. 21. 1929.

——— Vestiges de deux remplacements successifs de la 3ème molaire de lait chez l'Éléphant d'Asie (*Elephas indicus* Cuv.). Proc. Zool. Soc. London, 1931, pt. 3, pp. 723–727, figs. 1–2, pls. 1. September, 1931.

ANTONIUS, OTTO. Bemerkungen zu den Tieren des Weidholz-Imports 1930. Zool. Garten, Leipzig, n. F., vol. 4, nos. 6–7, pp. 204–222, figs. 1–22. July, 1931.

APPLETON, A. B. On the morphology of the cervico-costo-humeralis muscle of Gruber. Journ. Anat. London, vol. 63, pp. 437–446, figs. 2. 1929.

ARTEMENKO, B. A. Über die morphologische Bedeutung des M. transversus costarum. Anat. Anz. Jena, vol. 68, pp. 248–255, figs. 5. November 22, 1929.

ARX, M. v. Die Graphostatik und Kinematik in der Entwicklungslehre. Mathematisch-vergleichende Studien am Mammut- Schimpansen- und Menschenschädel. Zeitschr. Anat. Entw. -Geschl. Berlin, vol. 91, pp. 304–328, figs. 14. 1929.

ATHANASIU, SAVA and D. M. PREDA. Stratigrafia basinului inferior al Trotuşului. II. *Elephas meridionalis* din Pliocenul Superior dela Pralea-Căiuţi (Distr. Bacău). Annuar. Inst. Geol. României, vol. 13, pp. 65–84, fig. 1, map, pls. 2. (1928) 1929.

AYYAR, P. N. K. Notes on some rats damaging crops in South India. Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, pp. 937–946. March 2, 1931.

BABAULT, GUY. La capture et le dressage des éléphants d'Asie et Afrique. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 7, pp. 228–236. July, 1930.

BARBOUR, E. H. The American mastodon with mandibular tusks. Nebraska State Mus., vol. 1, bull. 19, pp. 163–170, figs. 103–108. March, 1931.

———— The giant beaver, Castoroides, and the common beaver, Castor, in Nebraska. Nebraska State Mus., vol. 1, bull. 20, pp. 171–186, figs. 109–120. June, 1931.

BEAUX, OSCAR DE. Collezioni zoologische fatte nell'Uganda dal Dott. E. Bayon. XIX. Mammiferi. Parte IV. Appendix, cum primatibus, insectivoris carnivorisque. Ann. Mus. civ. Storia Nat. Genova, vol. 52, pp. 100–107. (1925) 1928.

BELZ, HUGO. The black raccoon offers fur and food. Amer. Fur Breeder, vol. 4, no. 4, pp. 26–27. October, 1931.

BERGERSEN, BIRGER. Beiträge zur Kenntnis der Haut einiger Pinnipedien. Unter besonderer Berucksichtigung der Haut der Phoca groenlandica. Det Norske Videnskaps-Akad. i Oslo, I. Mat.-naturv. Kl., 1931, no. 5, pp. 1–179, figs. 92, pls. 22. 1931.

BERLIOZ, J. Les Mammifères de Scandinavie. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 10, no. 1, pp. 3–14. January, 1929.

BICKEL, EDMUND. Über Chinchilla-Zucht. Zool. Garten, Leipzig, n. F., vol. 4, nos. 1–2, pp. 63–65, figs. 1–3. February, 1931.

BIGLAKE, R. The longevity of wild animals in captivity. South African Journ. Nat. Hist., vol. 6, no. 4, pp. 297–302. June, 1929.

BIRULA, A. A. Preliminary note on the Quaternary Carnivora of the Crimea. Comptes Rendus Acad. Sci. USSR, ser. A, 1930, no. 6, pp. 139–144. 1930 (In Russian).

BLACK, DAVIDSON. Evidences of the use of fire by Sinanthropus. Bull. Geol. Soc. China, Peiping, vol. 11, no. 2, pp. 107–108. 1931.

BLAKE, IRVING H. Further studies on deciduous forest animal communities. Ecology, vol. 12, no. 3, pp. 508–527. July, 1931.

Boston, W. J. Answering some arguments against the white raccoon. Amer. Fur Breeder, vol. 4, no. 3, p. 29. September, 1931.

Bouet, G. and H. Neuville. Recherches sur le genre "Hylochœrus." Archiv. Mus. Nat. d'Hist. Nat., Paris (6), vol. 5, pp. 215–304, figs. 74, pls. 1–4. 1931.

Bourdelle, E. L'exposition internationale des animaux à fourrure. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 1, pp. 38–39. January, 1930.

——— La protection des mammifères dans les colonies Françaises. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 3, pp. 108–110. March, 1930.

——— La conservation et la présentation des mammifères dans les jardins zoologiques modernes. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 5, pp. 172–174. May, 1930.

——— and P. Mathias. A propos de quelques espèces de Cercopithèques du groupe des Mones et, en particulier, de *Cercopithecus erzlebeni*, *grayi* et *pogonias*. Bull. Mus. Nat. d'Hist. Nat., Paris, 1928, vol. 34, no. 5, pp. 306–310. 1928.

——— and P. Mathias. Considérations sur la valeur spécifique des caractères du pelage chez une Antilope (*Tragelaphus scriptus* Pallas). Bull. Mus. Nat. d'Hist. Nat., Paris, vol. 1, no. 3, pp. 177–185. 1929.

——— A. Mouquet and P. Mathias. La collection de primates de la ménagerie du Muséum National d'Histoire Naturelle. Bull. Mus. Nat. d'Hist. Nat., Paris, vol. 1, no. 4, pp. 234–238. 1929.

Brandes, Gustav. Wie alt wird der Orang-Utan? Zool. Garten, Leipzig, n. F., vol. 4, nos. 1–2, pp. 1–9, figs. 1–2. February, 1931.

Breadon, G. Local migration of the flying-fox (*Pteropus giganteus*) in the Punjab. Journ. Bombay Nat. Hist. Soc., vol. 35, no. 2, p. 439. October 15, 1931.

Brentana, Domenico. Osservazioni anatomico-sistematiche su resti di Bison priscus Boj. Comment. Dell'Ateneo Brescia, 1929, pp. 91–117, pls. 2. 1930.

Breuil, H. Le feu et l'industrie lithique et osseuse à Choukoutien. Bull. Geol. Soc. China, Peiping, vol. 11, no. 2, pp. 147–154. 1931.

Brownlow, A. L. Large head of Malay sambhar (*Cervus unicolor equinus*). Journ. Bombay Nat. Hist. Soc., vol. 35, no. 1, p. 199. June 15, 1931.

Brumwell, W. Rabbit fur production in England. Verhandl. des I. Internat. Kaninchenzüchter-Kongresses, Leipzig, 1930, pp. 138–143. 1931.

Burton, R. W. Cannibalism in panthers. Journ. Bombay Nat. Hist. Soc., vol. 35, no. 2, pp. 440–441. October 15, 1931.

——— The number of pups in a wild dog's litter. Journ. Bombay Nat. Hist. Soc., vol. 35, no. 2, p. 442. October 15, 1931.

——— Abnormal horns of sambur (*Cervus unicolor*). Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, pp. 1058–1059. March 2, 1931.

——— A variety of the thamin or brow-antlered deer (*Rucervus thamin*). Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, p. 1059. March 2, 1931.

Cabrera, A. La Patria de "Putorius furo." Boletin Real Soc. Española Hist. Nat., vol. 30, pp. 477–480. 1930. (Original home in Atlas Mountains, Spanish Morocco.)

CABRERA, A. Sobre los camélidos fósiles y actuales de la América austral. Revista del Museo de La Plata, Buenos Aires, vol. 33, pp. 89–117, figs. 4. Aug. 5, 1931. (*Viegna*, a misprint for *Vicugna*; keys to recognized genera and species and also synonymy of recognized species.)

——— and LUCAS KRAGLIEVICH. Diagnosis previas de los Ungulados fósiles del Arroyo Chasicó. Notas Preliminares del Museo de La Plata, Buenos Aires, vol. 1, pp. 107–113. September 30, 1931. (New: *Chasicotherium; C. rothi; Palaeotoxodon ? nazari; Hemixotodon; H. chasicoensis; Paratrigodon; P. euguii; Pseudohegetotherium; P. torresi; Protypotherium distinctum; P. minutum; Theosodon hystatus; Cullinia; C. levis.*)

CALABUCHOW, N. Die Auswanderung der jungen Zieselmäusen (*Citellus pygmaeus*) Pallas. als Ursache der Pestepizootien. Ber. Mikrobiol. Staats-Instituts. Rostow-am-Don, no. 9, p. 165. 1929.

CARBOU, M. Note sur les gazelles de la région de Tombouctou. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 1, pp. 26–32. January, 1930.

CAMERON, A. K. Fisher facts. Amer. Fur Breeder, vol. 4, no. 2, pp. 26–27. August, 1931.

CARVAJAL, E. Nota sobre un yacimiento de fósiles vertebrados en el Plioceno de la provincia de Logroño. Congrès Géol. Internat. Comptes Rendus, Madrid, vol. 14, no. 3, pp. 1017–1027, 1 map, pls. 12. (1926) 1928.

CHAPMAN, FRANK M. Seen from a tropical air castle. Natural History, vol. 31, no. 4, pp. 347–358, illus. July-August, 1931.

CHAPPELLIER, A. Les dangers de l'élevage du rat musqué (*Fiber zibethicus* Linne). Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 1, pp. 1–25, figs. 2. January, 1930.

CHARDIN, P. TEILHARD DE and C. C. YOUNG. Fossil mammals from the late Cenozoic of northern China. Palaeontologia Sinica, Peiping, ser. C., vol. 9, fasc. 1, pp. 88, figs. 23, pls. 10. 1931. (New: *Chalicomys broilii; Paralactaga zuni; Pararhizomys hipparionum; Prosiphneus sinensis; P. intermedius; Siphneus chanchenensis; S. minor; S. chaoyatseni; S. hsuchiapinensis; S. omegodon; Gazella paotehensis; G. blacki; Pachygazella; P. grangeri; Antilospira; A. licenti; Hipparion houfenense.*)

CHAVAN, R. Y. Measurements of a large Indian wolf (*Canis pallipes.*). Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, p. 1055. March 2, 1931.

COOK, HAROLD J. More evidence of mammoths in the high mountains of Colorado. Science, vol. 73, no. 1889, pp. 283–284. March 13, 1931.

CREPIN, PIERRE. Contribution a l'étude de la fourrure des ruminants domestiques. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 5, pp. 145–160, figs. 2. May, 1930.

——— La chèvre dans l'antiquité. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 10, no. 11, pp. 362–385. November, 1929.

D'AIGNEAUX, C. P. Vers une production française de l'astrakan. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 3, pp. 81–97. March 1930.

DECHAMBRE, ED. Étude du poil de l'Oreamnos americanus. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 7, pp. 221–227, fig. 1. July, 1930.

DERSCHEID, J. M. Cameroun, Sous Mandat Francais, 1930–1934. Revue Internationale de Legislation pour la Protection de la Nature, Bruxelles, pp. 3–16. 1931.

——— Cameroun, Sous Mandat Francais, 1916–1924. Revue Internationale de Legislation pour la Protection de la Nature, Bruxelles, pp. 37. 1931.

DICE, LEE R. The relation of mammalian distribution to vegetation types. The Scientific Monthly, vol. 33, pp. 312–317. October, 1931.

DOBROVOLSKAÏA-ZAVADSKAÏA, N. The problem of species in view of the origin of some new forms in mice. Biol. Reviews and Biol. Proc. Cambridge Philos. Soc., vol. 4, no. 4, pp. 327–351, pls. 8–11. October, 1929.

DUBOIS, GEORGES. Additions à la connaissance de la brèche à Lemmings de Maubeuge. Ann. Soc. Geol. du Nord, vol. 52, pp. 315–322, figs. 3. (1927) 1928.

——— Martre de la tourbe de Marquion. Ann. Soc. Geol. du Nord, vol. 52, pp. 280–285, figs. 5. (1927) 1928.

——— and G. PONTIER. Description de la molaire de lait d'Elephas primigenius trouvée à St. Druon, près Cambrai. Ann. Soc. Geol. du Nord, vol. 53, pp. 112–115, pl. 1. (1928) 1929.

DUVERNOY, HENRY. Comment installer un élevage de castor des marais. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 9, pp. 288–298. September, 1930.

EDGAR, J. H. The haunts of the giant panda. Journ. West China Border Res. Soc., vol. 3, p. 29. (1926–29) 1930.

EDGEWORTH, F. H. On the development of the external ocular, masticatory, and hyoid muscles Monotremata. Proc. Zool. Soc. London, Pt. 3, pp. 809–815, pls. 1–13. September, 1931.

——— On the muscles used in shutting and opening the mouth. Proc. Zool. Soc. London, 1931, pt. 3, pp. 817–818. September, 1931.

ELTON, CHARLES, E. B. FORD and JOHN R. BAKER. The health and parasites of a wild mouse population. Proc. Zool. Soc. London, 1931, pt. 3, pp. 657–721, figs. 1–15, tables 26. September, 1931.

FALKENSTEIN, B. and L. KREPS. Über die Entwicklung des Geweihs beim Axishirsch (*Axis axis* Erxl.). Zool. Garten, Leipzig, n. F., vol. 4, no. 6–7, pp. 222–226, figs. 1–3. July, 1931.

FINLAYSON, HEDLEY HERBERT. Observations on the South Australian species of the subgenus "Wallabia." Pt. 2. Trans. & Proc. Roy. Soc. South Australia, vol. 54, pp. 47–56, pls. 3. December 20, 1930.

——— Notes on some South and Central Australian mammals. Pt. 1. Trans. & Proc. Roy. Soc. South Australia, vol. 54, pp. 177–180. December 20, 1930.

FINNIE, O. S. Reindeer for the Canadian Eskimo. Natural History, vol. 31, no. 4, pp. 409–416, illus. July–August, 1931.

FLAHAUT, MARTHA R. Second locality record of big brown bat in western Washington. The Murrelet, vol. 12, no. 2, p. 56. May, 1931.

FLEROV, K. K. Essai sur la vie de l'ours brun dans l'Oural du Nord. Revue d' Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 7, pp. 237–240. July, 1930.

FLEROV, K. K. Quelques données sur la craniologie de la fam. Equidae. Comptes Rendus Acad. Sci. USSR., pp. 269–272, figs. 3. 1931. (In Russian, with English summary.)

FRECHKOP, SERGE. Notes sur les Mammifères. VI. Quelques observations sur la classification des Pangolins (Manidae). Bull. Mus. roy. d'Hist. nat. Belgique, Bruxelles, vol. 7, no. 22, pp. 1–14. September, 1931.

——— Notes sur les Mammifères. VII. Remarques sur quelques Mammifères provenant d'Atjeh (Sumatra). Bull. Mus. roy. d'Hist. nat. Belgique, Bruxelles, vol. 7, no. 28, pp. 1–6. October, 1931.

GERMINY, GUY DE. L'élevage du porc dans l'Italie centrale. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 11, pp. 356–363, figs. 3. November, 1930.

——— Monographie du porc-épic d'Italie. Revue d'Histoire Naturelle, Pt. 1. A, Mammifères, Paris, vol. 10, no. 11, pp. 386–391, figs. 2. November, 1929.

GOTHIER, FRANK, C. Mink breeding lessons learned during past year. Amer. Fur Breeder, vol. 4, no. 2, pp. 28–29. August, 1931.

GRAY, H. M. Common hare in the city of Edinburgh. Scottish Naturalist, no. 187, p. 25. January–February, 1931.

GREGORY, W. K. The African anatomical expedition of Columbia University and the American Museum of Natural History. Columbia Univ. Quart., vol. 23, no. 1, pp. 79–89. March, 1931.

——— A review of William Diller Matthew's contributions to mammalian palaeontology. Amer. Mus. Nov., no. 473, pp. 1–23. May 14, 1931.

GROMOVA, V. I. On the type of *Bison priscus* Bojanus. Comptes Rendus Acad. Sci. USSR., ser. A, 1930, no. 17, pp. 459–462, fig. 1. 1930. (In Russian.)

GUENTHER, KONRAD. A naturalist in Brazil. The flora and fauna and the people of Brazil. London: George Allen and Unwin, Ltd., pp. 400, 32 pls., 71 illus., and 40 figs. (Translated by Bernard Miall.) 1931.

HAINARD, ROBERT. Le "sifflet" de la marmotte. Bull. Soc. Zool. Genève, vol. 4, no. 3, pp. 201–206, pls. 2. April, 1931.

HALL, E. RAYMOND. On the occurrence of certain mammals in extreme southwestern Washington. The Murrelet, vol. 12, no. 1, pp. 22. January, 1931.

——— Tree-climbing Callospermophilus. The Murrelet, vol. 12, no. 2, p. 54. May, 1931.

——— The coyote and his control. California Fish and Game, Sacramento, vol. 17, no. 3, pp. 1–8, figs. 88–89. July, 1931.

HALL, MAURICE C. Parasite control in animals. Outdoor America, vol. 9, no. 12, pp. 16–17, 46, fig. July, 1931.

HIGGINS, J. C. The mithun. Journ. Bombay Nat. Hist. Soc., vol. 35, no. 2, pp. 444–445. October 15, 1931.

HJORT, JOHAN, GUNNAR JAHN, and SIGURD RISTING. International whaling statistics. II. Edited by the committee for whaling statistics appointed by the Norwegian Government. Det Norske Hvalråds Statistiske Publikasjoner, Oslo, pp. 1–68. 1931. (Contains a summary of whaling statistics from 1868 to 1909. Detailed statistics are given by regions and

by countries from 1909–1910 to 1929–1930. Figures are given for average oil production of blue whales in the Antarctic. The average sizes of blue whales and of fin whales taken during the season 1929–1930 are shown in tables.)

HOLMES, WALTER W., and GEORGE GAYLORD SIMPSON. Pleistocene exploration and fossil Edentates in Florida. Bull. Amer. Mus. Nat. Hist., vol. 59, art. 7, pp. 383–418, figs. 17. June 13, 1931.

HUBBARD, GEORGE D. New mastodon finds in European Turkey. Science, vol. 73, no. 1898, pp. 527–528. May 15, 1931.

HUEY, LAURENCE M. A new meadow mouse from Lower California, Mexico. Trans. San Diego Soc. Nat. Hist., vol. 7, no. 6, pp. 47–49. December 19, 1931. (New: *Microtus californicus grinnelli*.)

———— A new species and a new subspecies of pocket gopher. Trans. San Diego Soc. Nat. Hist., vol. 7, no. 5, pp. 43–46. December 19, 1931. (New: *Thomomys argusensis; T. bottae catavinensis*.)

IRBY, FLORENCE M. "Mirram"—"Little happy one." Australian Zool., vol. 7, pt. 1, pp. 11–14. August 24, 1931. (Growth of *Petaurus breviceps*.)

JACKSON, V. W. Ups and downs or periodic fluctuations in fur-bearing animals. Amer. Fur Breeder, vol. 4, no. 2, p. 32. August, 1931.

JEANNIN, A. Notes sur les mammifères du Cameroun. Revue d'Histoire Naturelle, Pt. 1. A, Mammifères, Paris, vol. 11, no. 5, pp. 161–165. May, 1930.

JOLEAUD, L. Les gazelles Nord-Africaines. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 3, pp. 106–107. March, 1930.

———— On the "Pachygenes" or "Pachygnathes" (thick-jawed Quaternary deer from Africa and Asia). Bull. Geol. Soc. China, Peiping, vol. 9, no. 3, pp. 195–203. 1930. (Comments upon *Cervus algericus*.)

JOUAN, M. Reproduction en captivité des fouines et des martres. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 11, pp. 364–366. November, 1930.

KHOMENKO, J. Bemerkungen zu: E. Pfizenmayer, Ein Desmostylidenzahn von der neusibirischen Insel Kotelnyi. Centralbl. Mineral. Geol. u. Paläontol., Abt. B, 1928, no. 9, pp. 519–520. 1928. (New: *Neodesmostylus; N. primigenius*.)

KINTNER, EDWARD. Notes on unearthing parts of a mastodon skeleton. Proc. Indiana Acad. Sci., vol. 39, pp. 237–239, figs. 3. (1929) 1930.

KRAGLIEVICH, LUCAS. Los grandes Roedores terciarios de la Argentina y sus relactiones con ciertos géneros Pléistocenos de las Antillas. Anal. Mus. Nac. Hist. Nat., Buenos Aires, vol. 34, pp. 121–135, pls. 7. 1926–1928. (New: *Eumegamyidae; Eumegamys*, new name for *Megamys* Auct., nec Laurillard; *E. paranensis; E. scalabrinianus; Isostylomys* for *Megamys laurillardi; Carlesia; C. pendolai; Telicomys* for *Testrastylus giganteus; Phoberomyinae; Phoberomys* for *Euphilus burmeisteri; Neoepiblemidae; Dabbenea; D. contorta; Tetrastylomys, T. castellanosi; Pentastylomys; P. seriei; Potamarchidae*.)

KROGMAN, W. M. Studies in growth changes in the skull and face of anthropoids. III. Growth changes in the skull and face of the gorilla. Amer. Journ. Anat., vol. 47, no. 1, pp. 89–115. January 15, 1931.

KROGMAN, W. M. Studies in growth changes in the skull and face of anthropoids. IV. Growth changes in the skull and face of the chimpanzee. Amer. Journ. Anat., vol. 47, no. 2, pp. 325–342. March 15, 1931.

———. Studies in growth changes in the skull and face of anthropoids. V. Growth changes in the skull and face of the orang-utan. Amer. Journ. Anat., vol. 47, no. 2, pp. 343–365, figs. 9. March 15, 1931.

KULAGIN, N. M. On the molting of the White Sea seal (*Histriophoca groenlandica* Lepechin). Comptes Rendus Acad. Sci. USSR., ser. A, 1928, no. 20–21, pp. 427–430, figs. 3. 1928. (In Russian.)

LIVESEY, T. R. Drumming sound made by leopards. Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, pp. 1056–1057. March 2, 1931.

——— The gayal, or mithan (*Bos frontalis*). Journ. Bombay Nat. Hist. Soc., vol. 35, no. 1, pp. 199–202, pl. 1. June 15, 1931.

MALBRANT, R. Notes sur les éléphants du Tchad. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 9, pp. 281–283. September, 1930.

MALBRANT, L. Notes sur les mammifères du Tchad. Revue d'Histoire Naturelle, Pt. 1, A. M ammifères, Paris, vol. 11, no. 11, pp. 345–355. November, 1930.

MARWICK, JAMES G. Long-eared bat in Orkney. Scottish Naturalist, 1931, no. 189, pp. 88–89. May–June, 1931.

MATHIAS, P. A propos d'un Gorille, *Gorilla gorilla rex pygmæorum* Schwarz, tué par M. Babault. Bull. Mus. Nat. d'Hist. Nat., Paris, 1928, vol. 34, no. 6, pp. 434–436. 1928.

MILLER, GERRIT S., JR. The Primate basis of human sexual behavior. Quart. Review Biol., Baltimore, vol. 6, no. 4, pp. 379–410. December 16, 1931.

——— Human hair and Primate patterning. Smithson. Misc. Coll., vol. 85, no. 10, pp. 13, pls. 5. December 19, 1931.

——— and JAMES W. GIDLEY. Mammals and how they are studied. Warm-blooded vertebrates, pt. 2, Smithson. Sci. Ser., vol. 9, pp. 171–389, figs. 25, pls. 70–124. December 17, 1931.

MISHIN, A. F. Determining the age of reindeer by the lower jaw molars. Sovetskii Sever, 1930, no. 7–8, pp. 65–68, figs. 12. 1930. (In Russian.)

MOREY, GEOFFREY. The world's queerest beast. Home-life of the duck-billed platypus. Field, London, vol. 158, p. 100, illus. July 18, 1931.

MORRIS, R. C. The Indian wild dog (*Cuon dukhunensis*). Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, pp. 1054–1055. March 2, 1931.

MOSSE, A. H. E. The panther as I have known him. Pts. 3–4. Journ. Bombay Nat. Hist. Soc., vol. 34, no. 3, pp. 673–693. November 15, 1930; no. 4, pp. 1015–1023. March 2, 1931.

——— On the food of the vampire bat (*Lyroderma lyra*). Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, pp. 1052–1053. March 2, 1931. (Common house gecko eaten by this bat; also known to eat mice and frogs.)

OGNEV, S. I. and V. G. HEPTNER. Mammals of the Middle Kopet-Dagh mountains and the adjacent plain (Russian Turkestan). Trans. Sci. Res. Institut Zool., Moscou, vol. 3, no. 1, pp. 47–171, figs. 23, pls. 3. 1929. (In Russian, with English summary.)

OLIVEIRA PINTO, OLIVERIO MARIO DE. Ensaio sobre a fauna de Sciurideos do Brasil, consoante sua representação nas collecções do Museu Paulista.

Rev. Mus. Paulista, Sao Paulo, vol. 17, no. 1, pp. 263–319, pls. 13. 1931. (New: *Guerlinguetus aestuans garbei; Urosciurus nigratus.*)

PANIN, G. Effect of climatic changes on the reindeer. Sovetskii Sever, 1930, nos. 7–8, pp. 60–64. 1930. (In Russian.)

PARVULESCU, M. V. La famille de chevaux sauvages du jardin des plantes de Paris. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 3, pp. 98–105, figs. 5. March, 1930.

——— La famille de chevaux sauvages du Jardin des Plantes de Paris. Bull. Mus. Nat. d'Hist. Nat. Paris, vol. 1, no. 5, pp. 298–303. June, 1929.

PEI, W. C. On a collection of mammalian fossils from Chiachiashan near Tangshan. Bull. Geol. Soc. China, Peiping, vol. 9, no. 4, pp. 371–377, figs. 5, 1930.

——— Mammalian remains from locality 5 at Chouk' outien. Palaeontologia Sinica, Peiping, ser. C, vol. 7, fasc. 2, pp. 18, fig. 1, pl. 1. 1931.

——— The age of Choukoutien fossiliferous deposit: A tentative determination by comparison with other later Cenozoic (Psychozoic) deposits in China. Bull. Geol. Soc. China, Peiping, vol. 10, pp. 165–178, fig. 1. 1931.

——— Notice of the discovery of quartz and other stone artifacts in the Lower Pleistocene hominid-bearing sediments of the Choukoutien cave deposit. Bull. Geol. Soc. China, Peiping, vol. 11, no. 2, pp. 109–146, figs. 15, pls. 3. 1931.

PHISALIX, M. Résistance des vertébrés inférieurs aux divers poisons et ses conséquences. Revue d'Histoire Naturelle, Pt. 1, A. Mammifères, Paris, vol. 11, no. 2, pp. 72–80. February, 1930.

PHYTHIAN ADAMS, E. G. The striped-necked mungoose (*Herpestes vitticollis*). Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, p. 1054. March 2, 1931.

PIRAUD, VICTOR. Au sujet de la disparition du lynx. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 10, no. 7, pp. 239–241. July, 1929.

POCOCK, R. I. Some external characters of the sea-otter (*Enhydra lutris*). Proc. Zool. Soc. London, 1928, pt. 4, pp. 983–991, illus. January, 1929.

——— Wanted bears. Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, p. 1052. March 2, 1931.

——— The mammal survey of the Eastern Ghats. Report on the monkeys. Journ. Bombay Nat. Hist. Soc., vol. 35, no. 1, pp. 51–59. June 15, 1931.

POETEREN, N. VAN. Wering en bestrijding van de bisamrat. Tijdschr. Plantenziekten, vol. 36, no. 10, pp. 249–255. 1930.

POISSON, H. Les lemuriens de Madagascar sont-ils susceptibles d'une exploitation rationnelle pour la production de la fourrure. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 9, pp. 299–302. September, 1930.

PONTIER, GEORGES. Les éléphants fossiles d'Abbeville. Ann. Soc. Geol. du Nord, vol. 53, pp. 20–46, figs. 4, pls. 4. (1928) 1929.

——— A propos d'anomalies dentaires observées chez les proboscidiens. Ann. Soc. Geol. du Nord, vol. 55, pp. 2–10, pls. 2, 1930.

POWELL, R. Swamp-deer (*Rucervus duvaucelli*) head with nineteen points. Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, p. 1060. March 2, 1931.

PYCRAFT, W. P. The standard natural history. London: Warne & Co., Ltd., Mammals, pp. 45–942, 12 col. pls., over 900 figs. 1931.

RAADT, O. L. E. DE Aanteekeningen over Indische ratten. Zool. Mededeel., Leiden, vol. 14, no. 1–2, pp. 43–51. 1931.

RAVEN, H. C. Gorilla: The greatest of all apes. Natural History, vol. 31, no. 3, pp. 231–242, figs. 12. May–June, 1931.

READ, BERNARD E. Chinese Materia Medica. Animal drugs. II. The wild animals. III. Rodentia. IV. Monkeys and supernatural beings. V. Man as a medicine. Peking Nat. Hist. Bull., vol. 6, pt. 2, pp. 1–102. September, 1931. (Use of mammals in medicine by the Chinese.)

RENOUF, L. P. W. Notes on small mammals of the Western Isles. Glasgow Nat., vol. 9, p. 65. (1919–1930) 1931.

REYNOLDS, EDWARD. The evolution of the human pelvis in relation to the mechanics of the erect posture. Papers Peabody Mus. Amer. Arch. & Ethnol., Harvard Univ., vol. 11, no. 5, pp. 255–334, figs. 10, pls. 3. 1931.

ROCHON-DUVIGNEAUD, A. 1. Autour du vaccares (pp. 41–55); 2. La reserve botanique et zoologique (pp. 55–61); 3. Philosophie de la Camargue (pp. 61–63). Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 2, pp. 41–63. February, 1930.

RODE, P. L'élevage, en terrarium, des petits rongeurs destinés aux recherches de laboratoire. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 7, pp. 209–220, figs. 3. July, 1930.

ROLLINAT, RAYMOND. Le Loup Commun *Canis lupus* Linné. Quelques-uns de ses méfaits sa disparition presque complète de France. Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 10, no. 4, pp. 105–129, pl. April, 1929; no. 7, pp. 209–238. July, 1929; no. 9, pp. 289–308. September, 1929.

RUND, JOHAN T. 1930. Trekk av hvalenes biologi. Naturen, Bergen, Ärg. 54, no. 9, pp. 261–282, illus. September, 1930.

SANDERS, C. W. Courage and cowardice of the hyaena. Journ. Bombay Nat. Hist. Soc., vol. 34, no. 4, pp. 1055–1056. March 2, 1931.

SCHANDER, R., and G. GÖTZE. Über Ratten und Rattenbekämpfung (mit besonderer Berücksichtigung der Wanderratte *Mus decumanus* Pall.) I. Lebensgewohnheiten, Auftreten und biologische Bekämpfung. II. Köderanwendung und chemische Bekämpfung. III. Mittelbewertung und mechanische Ratten-Bekämpfung. Zentralbl. Bakt. II Abt., vol. 81, no. 8–14, pp. 260–284, fig. 3; pp. 335–367, fig. 1; pp. 481–501, fig. 8. 1930.

SHAMEL, H. HAROLD. Bats from the Bahamas. Journ. Washington Acad. Sci., vol. 21, no. 11, pp. 251–253. June 4, 1931. (New: *Macrotus waterhousii heberfolium; Erophylla planifrons mariguanensis.*)

SCHEFFER, THEO. H. A freak skull of the California ground squirrel. The Murrelet, vol. 12, no. 1, p. 23, illus. January, 1931.

SCHNEIDER, KARL MAX. Das Flehmen. Zool. Garten, Leipzig, n. F., vol. 3, nos. 4–8, pp. 183–198, figs. 19. August 11, 1930.

SCHWARZ, ERNST. Ein Känguruhbastard "*Macropus hagenbecki* Rothschild." Zool. Garten, Leipzig, n. F., vol. 4, nos. 6–7, pp. 197–203, figs. 5. July, 1931.

SEREBRENNIKOV, M. K. On the polychromatism and albinism of the Siberian squirrels. Proc. Zool. Soc. London, 1931, pt. 2, pp. 493–495, pls. 1–3. June, 1931.

SHAH, S. Z. A case of hybridization between the wild-dog and the jackal. Journ. Bombay Nat. Hist. Soc., vol. 35, no. 1, pp. 198–199. June 15, 1931.

SMITH, G. ELLIOT. The ancestry of man. Bull. Geol. Soc. China, Peiping, vol. 9, no. 3, pp. 191–194. 1930.

SODERSTROM, ERIC. The mink situation in Sweden. Amer. Fur Breeder, vol. 4, no. 1, p. 29. July, 1931.

SODY, H. J. V. Two new races of Rattus lepturus from Java. Natuurkundig Tijdschr. Nederlandsch Indië, vol. 91, no. 2, pp. 212–215. 1931. (New: *Rattus lepturus fredericae; R. l. besuki.*)

——— Six new mammals from Sumatra, Java, Bali and Borneo. Natuurkundig Tijdschr. Nederlandsch Indië, vol. 91, no. 3, pp. 349–360. 1931. (New: *Pithecus pyrrhus kohlbruggei; Viverricula malaccensis atchinensis; V. m. baliensis; V. m. muriavensis; Tragulus javanicus neubronneri; Saccolaimus flavimaculatus.*)

SOPER, J. DEWEY. A faunal investigation of southern Baffin Island. Nat. Mus. Canada, bull. 53, pp. 1–143, pls. 1–7, 1 fold. map. 1928.

SOWERBY, ARTHUR DE C. The sika, or spotted deer of eastern Asia. China Journ., vol. 11, pp. 192–195, pls. 3. October, 1929.

STEHLIN, H. G. Artiodactylen mit fünffingriger Vorderextremität aus dem europäischen Oligocän. Verhandl. Naturforsch. Ges. Basel, vol. 40, pt. 2, pp. 599–625, figs. 13. (1928–1929) 1929.

STILES, C. W. Is an International Zoological Nomenclature practicable? Science, vol. 73, no. 1892, pp. 349–354. April 3, 1931.

STIRTON, R. A. A new genus of Artiodactyla from the Clarendon Lower Pliocene of Texas. Univ. Calif. Publ., Bull. Dept. Geol. Sci. vol. 21, no. 6, pp. 147–168, figs. 3, pls. 6–11. February 26, 1932. (New: *Synthetoceras; S. tricornatus.*).

STRAND, EMBRIK. Bemerkungen über drei Affen aus Abyssinien. Folia Zool. et Hydrobiol., Univ. Lettlands, Riga, vol. 3, no. 2, pp. 191–198. 1931. (Comments on *Cercopithecus hilgerti, Colobus abyssinicus* and *Papio hamadryas.*)

——— A proposito di Edentati fossili Sud Americani. Rivista Italiana di paleontologia, vol. 37, fasc. 3–4, pp. 65–70. 1931.

STROMER. ERNST. Wirbeltiere im obermiocänen Flinz Münchens. Abhandl. Bayerischen Akad. Wiss. Math.-Nat. Abt., vol. 32, no. 1, pp. 1–71, figs. 3, pls. 3. 1929. (New: *Miospalax; M. monacensis; Miotragocerus; M. monacensis.*)

SVIHLA, RUTH DOWELL. Les moeurs du lapin des marais *Sylvilagus aquaticus littoralis.* Revue d'Histoire Naturelle, Pt. 1, A, Mammifères, Paris, vol. 11, no. 1, pp. 33–37. January, 1930.

SVIHLA, ARTHUR. The Olympic red-backed mouse. The Murrelet, vol. 12, no. 2, p. 54. May, 1931.

——— and RUTH DOWELL SVIHLA. Mink feeding on clams. Murrelet, vol. 12, no. 1, p. 22. January, 1931.

TEODOREANU, N. Ueber ein Quartärpferd aus Transilvanien, "Equus transilvanicus." Bull. Sect. Sci. Acad. Roumaine, Bucharest, vol. 10, no. 2, pp. 17–24, figs. 4, 1926. (New: *Equus transilvanicus.*)

TODD, T. WINGATE. The anatomical features of epiphysial union. Child Development, vol. 1, no. 3, pp. 186–194. September, 1930.

——— Facial growth and mandibular adjustment. Internat. Journ. Orthodontia, Oral Surg., and Radiography, St. Louis, vol. 16, no. 12, pp. 3–27, figs. 19. December, 1930.

——— The roentgenographic appraisement of skeletal differentiation. Child Development, vol. 1, no. 4, pp. 298–310. December, 1930.

——— Differential skeletal maturation in relation to sex, race, variability and disease. Child Development, vol. 2, no. 1, pp. 49–65, figs. 7. March, 1931.

——— The natural history of human growth. Brush Foundation Publ. no. 12, pp. 15. March 15, 1931.

——— Life's impact and youth's adjustment. Brush Foundation Publ. no. 13, pp. 19. March 22, 1931.

——— and BARBARA TRACY. Racial features in the American negro cranium. Amer. Journ. Phys. Anthrop., vol. 15, no. 1, pp. 53–110, figs. 22. October–December, 1930.

TOKUNAGA, SHIGEYASU. Fossils of Rhinocerotidae found in Japan. Proc. Imp. Acad. Japan, vol. 2, no. 6, pp. 289–291. 1926. (New: *Teleoceras* (?) *kaniensis; T.* (?) *tokiensis; Aceratherium* (?) *watanabei*; *A* (?) *makii*,)

TROUGHTON, ELLIS LE G. Three new bats of the gerera *Pteropus, Nyctimene,* and *Chaerephon* from Melanesia. Proc. Linn. Soc. N.S. Wales, vol. 56, pt. 3, pp. 204–209. 1931. (New: *Pteropus howensis; Nyctimene sanctacrucis; Chaerephon solomonis.*)

UCHIDA, SEINOSUKE. The present condition of the protection of birds and mammamals in Japan. Tokyo. Dept. of Animal Industry, Ministry of Agriculture and Forestry. 1927.

WEIDENREICH, FRANZ. Über die systematische Stellung des *Australopithecus africanus* Dart. Natur. u. Mus., Frankfurt a.M., vol. 61, no. 5, pp. 229–234, figs. 6. May, 1931.

WILKIE, H. C. The attachments of the auditory ossicles of the common mole (*Talpa europaea*). Proc. Zool. Soc. London, 1929, pt. 1, pp. 61–65, illus. April, 1929.

WOOD, CASEY A. An introduction to the literature of vertebrate zoology, based chiefly on the titles in the Blacker Library of Zoology, the Emma Shearer Wood Library of Ornithology, the Bibliotheca Osleriana and other libraries of McGill University, Montreal. London: Oxford University Press, pp. xix + 643. 1931.

YOUNG, C. C. Die stratigraphische und palæontologische Bedeutung der fossilen Nagetiere Chinas. Bull. Geol. Soc. China, Peiping, vol. 10, pp. 159–164, tables 1–3. 1931.

ZDANSKY, OTTO. Die Alttertiären Säugetiere Chinas nebst stratigraphischen Bemerkungen. Geol. Surv. China, Palaeontologia Sinica, ser. C. vol. 6, no. 2, pp. 1–87, pls. 5, figs. 7. 1930. (New: *Ictopidium; I. lechei; Cricetodon schaubii; Anthracosenex; A. ambiguus; A. ? sinense; Cristidentinus; C. depereti; Diplolophodon; D. similis; Amynodon sinensis; Propalacotherium sinense; Heptaconodon; H. dubium; Eomoropus ? quadridentatus; E. ? major; E. ?minimus; Grangeria; G. canina; Hoanghonius; H. stehlinii.*)

COMMENT AND NEWS

"CONTROL, NOT EXTERMINATION," OF CYNOMYS LUDOVICIANUS ARIZONENSIS

The following extracts from my field records and correspondence sent by me to the Museum of Vertebrate Zoology during the summer of 1931, while seeking topotypes of mammals in the southwestern United States, may interest readers of the Journal of Mammalogy in that they show how "control, not extermination" may act on some species of our native fauna. More than ordinary importance attaches to the present case because the animals involved seem to be the very last topotypic individuals of their kind.

July 18, 1931: "The Wilcox prairie dog is supposed to be extinct in this county, but we learned of a small colony of about fifteen individuals, six miles from Wilcox, marked for poisoning by the Federal agent. We have made two unsuccessful shooting raids on them and are trying once more tonight with traps."

July 28, 1931: "On our return to Wilcox will try again for prairie dogs, provided of course, they have not yet been poisoned. We have written Mr. Sam Armstrong, Agricultural Agent at Wilcox, soliciting his co-operation in the matter. All our enquiries along the road have met with the same response: 'Prairie dogs used to be here but they have all been killed off.' Even Mr. Hunt, at the San Bernardino Ranch on the Mexican border, could give us no clue as to any existent colonies."

August 13, 1931: "We came back here of course on account of the prairie dogs. Mr. Armstrong, the County Agricultural Agent, put a boy on the job who he said was a crack shot. The boy was not successful, so an experienced trapper was pressed into service, with the result that we have three topotypes of *Cynomys ludovicianus arizonensis*, 'the last of the Mohicans,' because Mr. Armstrong states very emphatically that the little colony (about 20) will be poisoned this year."

September 8, 1931: "The colony near Wilcox is located in a small grassy depression in the midst of alkali flats, which in themselves would not favor the extension of the colony."

With reference to prairie dogs in another state, in this case New Mexico, on September 8, 1931, I wrote as follows: "On our recent visit to Animas Valley, Hidalgo County, New Mexico, we found a colony occupying about fifty acres on one of the Diamond A ranches about seven miles north of the Gray Ranch. After getting our series of topotypes of *Thomomys mearnsi* we returned to the colony and camped there for a couple of days, while Miss Kellogg obtained two mature males. A neighbor farmer driving by, thinking we might be Mr. Echols, the government trapper, stopped to see us. He said he wanted to complain against the use of poisoned grain at the holes, as the cattle and horses licked it up and were made quite ill. This colony (really three colonies separated from one another by a mile or two) is the first we have encountered since leaving Wilcox. Another small colony is said to exist above the Culberson Ranch at the lower end of the Playas Valley. Mrs. Chaney, wife of the foreman on the Lard Place, a Diamond A ranch about eleven miles north of the Culberson, said the Playas Valley used to abound in prairie dogs but at the time of the war a disease nearly exterminated them. Her husband, however, did not agree with her and said they had been poisoned by the Federal agents."

"Incidentally we have noticed that the big *Dipodomys spectabilis* is also an object for destruction by the Federal agents."—ANNIE M. ALEXANDER, *The Regillus, Oakland, California.*

KRUGER NATIONAL PARK

The Cockerell-Mackie-Ogilvie African Expedition of 1931 collected over sixteen thousand insects and a good many mollusks, but made no contributions to the technical knowledge of mammals. Nevertheless, it may be worth while to record here our impressions of Kruger National Park—probably the most successful and interesting wild animal reserve in the world. Kruger Park was established in 1926, and is described in the South and East African Year Book for 1931 as covering all game reserves in the eastern portion of the Transvaal, with an area of 8,652 square miles, "or nearly the size of the four largest United States parks." It is 211 miles long from north to south, with an average breadth of 37 miles. There are nearly 300 miles of motor roads, and others are under construction. There are excellent rest camps, with small round houses built in the native style, but no hotels. Visitors are allowed to travel on the roads in their cars, or those they have hired, but may not leave their cars except at the rest camps. Game wardens continually patrol the park and enforce the rules. Everything is left in its natural state, and the animals are only those native in the district. We were informed that when the reserve was first established, the large animals were scarce and rarely seen, but under strict protection they have increased enormously. The Year Book states that it is estimated that there are about 100 elephants, 10 black rhinoceroses, 250 giraffes, 200 hippopotamuses, 800 African buffaloes, and between 400 and 500 fully grown lions. There are believed to be about 120,000 antelopes, of many species, and zebras are very numerous.

We went by train from Pretoria to Nelspruit, and everything was arranged with the kind assistance of Mr. Herbert Lang, the well-known zoologist and explorer of the Congo. At Nelspruit we hired a car, and were fortunate in getting a very experienced guide and driver, Mr. J. H. Van Rooyen. As soon as we reached the park, we began to see great quantities of zebras (*Equus burchelli transvaalensis* Ewart), in excellent condition, and appearing truly beautiful among the small trees. Wildebeest (*Connochaetes taurinus* Burchell) were even more numerous, and presently many other antelopes came in sight, including perhaps six or eight species. Graceful impalla (*Aepyceros malampus* Licht.) raced across the road, jumping like grasshoppers at intervals. Sable antelopes (*Hippotragus*) stood in dignified poses not far from the road. Giraffes (*Giraffa capensis* Lesson) were so numerous that we soon ceased to count them. Wart hogs (*Phacochoerus aethiopicus sundevalli* Lönnberg) were innumerable, and always amusing. In the course of three days we saw no less than twenty-three lions (presumably *Leo leo melanochaitus* (Ham. Smith), or *Felis leo melanochaitus*). The color of the mane seems to be variable. Miss Mackie got an excellent moving picture of an adult male lion, standing close to us in the grass, waving his tail. He was resting when first seen, and we had to make various demonstrations to make him get up. A lioness and her cubs were feeding on a wildebeest. One large lion limped painfully, a hind leg apparently having been broken, perhaps by a kick from a zebra. Altogether our trip to Kruger Park was a most wonderful experience. The so-called wild animals, when protected, are no longer very wild, and it is easy to get near to them and photograph them from an automobile. The "balance of nature" seems to be self-regulating; the numerous lions eat the antelopes, but the latter multiply fast enough to more than keep up their numbers. The pasture seems sufficient,

and the animals appear well fed.—T. D. A. COCKERELL, *University of Colorado, Boulder, Colorado.*

CHILLINGHAM CASTLE LET

The Earl of Tankerville has leased to Viscount Grey of Fallodon, Mr. Hugh S. Gladstone, and Sir Peter Chalmers Mitchell, Trustees appointed for the purpose by the Council of the Zoological Society of London, the park at Chillingham Castle in Northumberland for the purpose of preserving the famous herd of white park cattle.

For centuries the castle was one of the strongholds of the famous Border family of Grey of Wark. In Stuart times Lord Grey commanded Monmouth's cavalry at the Battle of Sedgemoor, being later created Earl of Tankerville by William of Orange, a title held by the family in the fifteenth century. The park surrounding the castle grounds is noted as being the home of the famous herd of wild white cattle, whose origin has given rise to much speculation.

The corresponding secretary, Robert T. Hatt, will be away from his office during the month of August and requests the indulgence of any whose letters are not promptly answered during that month.

COMBINATION POCKET TELESCOPE AND MICROSCOPE

Two-in-one; three (40–50 & 60), instantly changeable powers in each.

A German 7 inch instrument complete $15

POCKET PRISM BINOCULARS

New and used. In 3½, 4, 5, 6, 7 and 8-powers. Four to 12 ounces in weight; $13 to $70.

Busch, Hensold (Dialyt), Mirakel, Zeiss, Maxim, Night-Hawk and others. We carry everything in glasses up to 24-power.

Satisfaction guaranteed.

J. ALDEN LORING, Box SM, Owego, N. Y.

A New Journal

The Journal of Animal Ecology

Edited for *The British Ecological Society* by CHARLES ELTON AND A. D. MIDDLETON (University Museum, Oxford)

A New Journal which is intended to act as the organ of research on Animal Ecology in the British Isles. This journal will publish primarily papers dealing exclusively with animals (such as population and migration studies and allied problems), and with methods of ecological research having reference primarily to animals. Two numbers will be published each year, in May and November. Subscription for members of the *British Ecological Society* is 25s. per annum, and for non-members, or libraries and institutions, 30s. per annum.

The net prices of single parts will be 22s. 6d. net.

The First Number is Now Ready

CAMBRIDGE UNIVERSITY PRESS Fetter Lane, London, E. C. 4

Back volumes of the
Journal of Mammalogy
are still available as follows:

Vol. 1. (1919–1920, 5 numbers)	$8.25
Vol. 2. (1921)	7.50
Vol. 3. (1922)	10.00
Vol. 4. (1923)	4.00
Vol. 5. (1924)	7.50
Vol. 6. (1925)	4.00
Vol. 7. (1926)	4.00
Vol. 8. (1927)	4.00
Vol. 9. (1928)	4.00
Vol. 10. (1929)	4.00
Vol. 11. (1930)	4.00
Vol. 12. (1931)	4.00

A discount of 20 per cent is allowed to members in good standing.

There is a small surplus of several odd numbers at $1.00 each.

Monographs of the American Society of Mammalogists:

1. **Anatomy of the Wood Rat,** by A. BRAZIER HOWELL.....$5.00

225 pages, 34 line drawings, 8 color plates and three half-tones.

Members are allowed a discount of 8 per cent.

2. **The Beaver: Its work and ways,** by EDWARD R. WARREN.....$1.00

177 pages, 78 halftones and diagrams.

3. **Animal Life of the Carlsbad Cavern,** by VERNON BAILEY....$1.00

192 pages, 66 halftones, 2 maps, 1 colored.

Robert T. Hatt, *Corresponding Secretary*

The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y.

JOURNAL OF MAMMALOGY

CONTENTS

The Songs of Mice ..... *Lee R. Dice* 187

Mammals Collected or Observed in the Vicinity of Laurier Pass, B. C. *W. G. Sheldon* 196

Notes on Mammals of Menominee Indian Reservation, Wisconsin *E. V. Komarek* 203

Local Differences in Pelage Characters of Peromyscus .... *R. R. Huestis* 210

A Test of some Rodent and Bird Influences on Western Yellow Pine Reproduction at Fort Valley, Flagstaff, Arizona *Walter P. Taylor and D. M. Gorsuch* 218

Distribution of the South American Shrews ..... *G. H. H. Tate* 223

Records and Distribution of the Fossil Beaver, Castoroides ohioensis *Alvin R. Cahn* 229

The Panniculus Carnosus and Pouch Musculature of the Opossum, a Marsupial ..... *Orthello R. Langworthy* 241

Status of International Convention for Protection of Whales *Lewis Radcliffe* 251

A Pleistocene Bat from Florida ..... *Glover M. Allen* 256

A New Shrew of the Sorex merriami Group from Arizona *E. Raymond Hall* 259

Hyaenognathus from the Late Pliocene of the Coso Mountains, California *Chester Stock* 263

A New Beaver from Arizona ..... *E. A. Goldman* 266

Preliminary Description of Two New Palearctic Voles *Anatol. I. Argyropulo* 268

General Notes 272

Myotis grisescens and Myotis sodalis in Tennessee and Alabama, *Charles E. Mohr*; The Roosting-place of Pipistrellus hesperus, *Jack C. von Bloeker, Jr.*; Summer Records of Eumops californicus (Merriam), *Jack C. von Bloeker, Jr.*; Diphyllobothrium latum in Bear, *W. M. Rush*; Kamchatka Sable Nearing Extinction, *Walter J. Eyerdam*; Occurrence of the Least Weasel in Michigan, *Ned Dearborn*; The Franklin Spermophile in Ontario, *Morris M. Green*; Winter Activities of the Eastern Chipmunk, *Frederick H. Test*; A Somewhat Unusual Kitchen Midden of Fremont's Squirrel (Sciurus fremonti fremonti), *Edward R. Warren*; Unusual Abundance of Pocket Mice at San Felipe Narrows, California, *Jack C. von Bloeker, Jr.*; New Locality Records for Perognathus baileyi from California, *Jack C. von Bloeker, Jr.*; Note on "Cosomys" Wilson, from the Pliocene of California, *Martin A. C. Hinton*; A Shipment of Muskrats to Kamchatka, *Walter J. Eyerdam*; A "Horned" Blacktail Doe with Fawn, *Lester J. Berry*.

Fourteenth Annual Meeting of the American Society of Mammalogists. 283

Recent Literature 290

Comment and News 302